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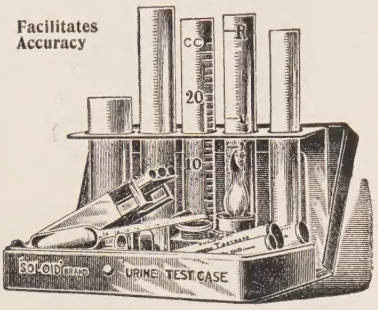

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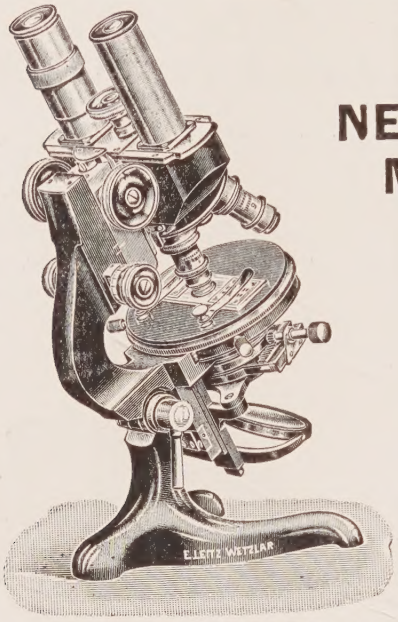

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TROPICAL DISEASES BUREAU.

TROPICAL DISEASES BULLETIN.

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APPLIED HYGIENE IN THE TROPICS.

By Colonel W. G. King, C.I.E., I.M.S. (Retired).

REPORTS.

Sanitary Commissioner with the Government of Madras.

The rainfall for the year was below the normal. The prices of the staple grains increased from 22 to 26·5 per cent. above the average. Using the census figures of 1911, the total estimated population of 1912 was 42,437,798. Allowing for excess of births over deaths, registration figures almost coincided with this calculation. Nevertheless, the Sanitary Commissioner points to several areas where registration has been inefficiently conducted, and urge the reorganization of the registration agency. In this connection he advises the extension of what is known locally as the " Trial Scheme," where, in rural areas, compulsory registration of births and deaths is part of the vaccination scheme, as likely to lead to improved results. Per mille of the population, the total registered birth-rate was 30·4, the total death-rate 23·1. Death-rates for special diseases were, per mille—cholera 1·4, plague 0·4 (against ·11 for several years), " fever " (unclassified) 7·4, diarrhoea and dysentery 1·6. Injuries claimed 0·3 per mille, of which suicides were accounted for in the proportion of 111 females to 100 males—a peculiarity of statistics having a probable relation to caste and social problems of Hindus.

The Sanitary Commissioner had reason, in his Report of 1911, to invite certain Municipalities to use more diligence as to conservancy, and to cease their attempts to divert the energies of their Sanitary Inspectors from their legitimate duties to those connected with general administration. He, however, in the present Report, is able to give a more favourable account of these matters.

*Report of the Sanitary Commissioner with the Government of Madras (1912).—1914, Madras. Printed by the Superintendent, Government Press.

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Fourteen District Municipalities and the Madras City conduct sewage farming by broad irrigation. Five of these farms were worked at a profit. The crops grown are English and country vegetables, grasses, tobacco, plantains (bananas), sugar-cane, and coconut trees. Bacterial filters, or septic tanks, are used before disposal on land in four Municipalities. Rubbish after stacking, and night-soil after trenching, obtain a sale in 18 Municipalities. Four Municipalities let their trenching grounds, after completion, for cultivation.

In 32 of the total 62 Municipalities (population 2,601,926) large sums were spent with the object of improving congested areas. The Sanitary Commissioner looks forward to the impetus in sanitation in Municipal areas, which the supervision of the present staff of Certificated Sanitary Inspectors, by the addition, in 12 towns, of 1st Class Health Officers, and in 19, of 2nd Class Officers, will afford. He specially advises that such rulings be introduced on their engagement as will prevent these men becoming "mere post offices" between the Municipal Chairmen and the subordinate sanitary staffs.

The Sanitary Commissioner animadverts upon the incomplete condition of the sanitary staffs in rural areas. Seven District Boards subsequent to 1903 engaged "Sanitary Assistants" to the District Medical and Sanitary Officer (Civil Surgeon), to fulfil the function of District Health Officers; "for financial reasons," two of these Boards abolished their officers. The permanent executive staff is thus reduced in some of the rural areas to an insufficient number of Certificated Sanitary Inspectors, in charge of Unions and Taluks. On this undesirable state of affairs the Sanitary Commissioner remarks :—

"The employment of Sanitary Assistants is sound in principle and in practice. Judging by reports received from them, they have been of considerable service in districts employing them in checking vaccination work and correcting sanitary errors in towns and villages inspected by them, although funds have not always been forthcoming to give effect to the more important of their recommendations. Their extended employment must follow as the logical sequence of the reforms recently inaugurated; for without an intermediate subordinate staff of Sanitary Assistants or District Health Officers, as they should be rightly designated, and their further sub-division into Sanitary Inspectors, the employment of officers alone will be of little practical value."

The Sanitary Commissioner is able to report a more general adoption of wells in villages according to type designs issued, and records the helpful action of Government in providing, as an experimental measure, correctly covered wells, with semi-rotary pumps attached, in a certain number of villages.

On the Register of Certificated Sanitary Inspectors of the Madras Presidency there are over 700 men who have qualified at their own expense; but the Sanitary Commissioner states that, owing to the indifferent pay and conditions of service offered at the present time, he has found difficulty in securing quickly men for epidemic duty. Hence, on his recommendation, the Madras Government has placed at his disposal a permanent reserve of twenty Sanitary Inspectors, with sanction for engagement of menials for disinfection and other duties. These will be available for duty in any part of the Presidency for emergent epidemic duty, where local staffs require strengthening; and, when not so used, they will be employed for anti-malarial work.

Twenty of the Municipalities of this Presidency have now piped-water supplies, and the Sanitary Commissioner is able to point to a decrease of cholera following their introduction.

In regard to the anti-malarial measures, cessation of wet cultivation in and around the malarious town of Cuddapah has been followed by a decrease of fever mortality of 1·5 per mille. The special malarial officer, Major T. S. Ross, I.M.S., completed his investigation at Ennore and vicinity. His preventive measures have been followed with excellent results, and the Sanitary Commissioner considers that "malarial fevers will completely disappear from the area." The practical measures suggested by Major Ross are estimated to cost Rs.87,000. The area is under the District Board, Chingleput, which received a contribution towards this work of Rs.28,000 from Government.

The Sanitary Commissioner attaches the usual list showing the places inspected, and the duties calling for this action. This suffices to show that the post of Sanitary Commissioner with the Government of Madras is no sinecure. Practically, he was on tour for the greater part of each month during both the wet and hot seasons; implying considerable exposure to climatic conditions, coupled with inspection often involving much physical work—to be followed by prompt compilation of reports and office work. He concludes his Report with the following statement:—

"During the year a steady advance has been made in sanitary progress. While we have reason to be thankful for the advance that is being made, there can be no doubt that advantage should be taken of the improved financial condition of the country to redouble our efforts to improve the sanitation of both rural and urban areas, and thereby retain the position that Madras has held in the past, in matters sanitary, *facile princeps* in India."

Remarks.—The chief note struck by the Sanitary Commissioner is the necessity for completion of the existing sanitary organization in the rural areas of the Madras Presidency, and all practical sanitarians will sympathise with him in recognizing that without both an efficient and sufficient sanitary staff at disposal, efforts towards public health must be largely limited to the *vox et praeterea nihil* method of administration. The question is, however, attacked without despondency; for, notwithstanding the defects he specifies, he makes no idle boast that, up to date, the Presidency of Madras is *facile princeps* in sanitary matters in India. There have been few years in that part of India which have not been marked by progress both in sanitary works and sanitary administration. Indeed, in some important subjects connected with public health, Madras has not only preceded in action the rest of India, but also of Great Britain. Such as in the training of certificated midwives for use by public bodies, for free attendance at the houses of the poor and at hospitals (prior to 1862); the *compulsory* training of Certificated Sanitary Inspectors appointed by both urban and rural local bodies (1893–'94); the discouragement (1890) and ultimately the entire prohibition of use of humanized lymph* by public vaccinators in favour of animal vaccine

*Its use was discouraged by special Government orders in 1890; but difficulty was experienced in maintaining vitality of animal vaccine under tropical conditions during prolonged transport. Experiments [W. G. King] made in Madras in 1890 discovered the utility of lanoline for preservation of animal vaccine. This was adopted and is now employed by the Madras, Bengal and Mysore Governments.

(1894–'95); re-vaccination of all candidates for public employment (1894); the teaching of hygiene in schools (prior to 1880); the compulsory inspection by Government Medical Officers and official report thereon of scholars and schools receiving any form of aid from public funds (1886); the inauguration of examinations in elementary and advanced grade of hygiene* in connection with schools and Government technical examinations (1893); the providing of a Central Institute suitably equipped, whence bodies in charge of administration of 41,000,000 people are supplied with preserved animal vaccine, and the right of aid, free of charge, in bacteriological and chemical matters concerning public health (1902–'03). Whilst the principle of local self-government results in varied degrees of application, the Presidency possesses, in simple form, useful Acts which give sanitary powers in many useful details not yet attempted in Great Britain. Moreover, having regard to former days of scanty funds, when provincial settlements were arranged on the principle of Madras being the "milch cow of India," the Madras Government has never stinted aid to Local Bodies in the matter of sanitary works; so that, seeing the first Government Sanitary Engineer was appointed as late as 1893, the existence of piped water-supplies in twenty Municipalities is no mean record.

Northern Nigeria.†

Medical Section.—Northern Nigeria has a native population of approximately 9,269,000. It is now a portion of the amalgamated Province of Northern and Southern Nigeria under the Governorship of Sir F. D. Lugard, with an estimated population of 17,000,000, and an area of 335,000 square miles. This union must prove of advantage in the medical and sanitary interests of both areas, in view of the fast increasing coast and railway communications, bringing with them various problems of public health, which cannot readily be treated from the standpoint of a single Province.

In 1913, of a total of 804 Europeans, 326 were resident officials. Of the former number, the death rate was 16, and of officials considered separately 12·2, per mille. The year was remarkable for shortage of rainfall, which was particularly apparent at Geidam, where only 5·75 inches were registered. Here the rainfall has, according to registration maintained since 1908, shown a steady annual decline as follows:—In inches—22·39, 21·88, 16·71, and 5·76. Geidam also has the distinction of having registered the highest shade temperature, namely 116 F. and the lowest mean relative humidity, 37.

In the matter of provision of hospitals for Europeans, an advance has been made by opening a temporary hospital at Kaduna, but the Principal Medical Officer considers another hospital is necessary between that point (which is to be the future capital of the Province) and

*Up to 1913, 2,755 candidates appeared for the elementary grade, of whom 1,166 qualified, and for the advanced grade (intermediate) 1,826, of whom 1,029 qualified.

†Northern Nigeria.—Annual Medical and Sanitary Report for the year ending 31st December, 1913. [Principal Medical Officer, F. Manning; Senior Sanitary Officer, M. Cameron Blair.]—f'cap. 1914. Printed by Waterlow & Son, Ltd., London.

Ibadan, as well as at Naraguta. The new Kaduna hospital is a railway employees' bungalow, adapted for the special purpose. As a structure it is confessedly a makeshift; the Medical Department has probably done the best in being content with cheap alterations, and as the original and new structures are not differentiated in the plan, it is unnecessary to be critical, beyond suggesting that there is displayed, throughout, less regard of the virtue of perflation than even the 2,000 feet elevation of Kaduna justifies. In the Northern Province there are three in-patient hospitals of a permanent character for natives; semi-permanent (mud-built with concrete floors) hospitals are also available at 18 stations. Three out-patient dispensaries are supported by native Treasuries; a combined native in-patient hospital and dispensary is also under contemplation.

In 1913, 1,535 Europeans were admitted for treatment, and 22,385 natives. Amongst the latter there were 12 cases of bilharziasis, of *Taenia solium* there were 137 cases, *T. saginata* 426, *T. lata* 2, *Ascaris lumbricoides* 89, *Dracunculus* 426, filariasis 31, ankylostoma 98, *Oxyuris vermicularis* 33. 951 cases of leprosy were treated, sleeping sickness 4, beriberi 7, enteric fever 1, malaria 1,152. It would thus seem that, in suppressing these diseases, there is a large scope not only for curative but for preventive medicine, seeing that the frequency of these diseases can only be vaguely guessed at by using the total number which happened to have applied for treatment. The number of cases of leprosy, even as thus exhibited, must be regarded as of considerable importance in the future history of the Province.

Amongst Europeans, of 13 deaths 6 were due to blackwater fever, for which disease there was a total of 16 admissions. The Principal Medical Officer calls special attention to the fact that there were 62 admissions for diseases of the nervous system, and that 6 persons were invalided under this head.

Difficulties were experienced in securing men fit for training as vaccinators, as well as of staff for supervising them; although this is being attempted with the admittedly unsuitable personnel locally available. 11,801 vaccinations are reported to have been conducted by "dried lymph" supplied by the Lister Institute, with the success rate of 84·8 per cent. How grave is the necessity for pushing vaccination on a sound basis is evident from a table supplied in the Report, from which it is found that in a population of 11,892 small-pox mortality was at the rate of 10·9 per mille, with a death rate of 29·3 per cent. of the attacks; in another of 10,000, the small-pox death-rate was 9 per mille, and in a population of 8,545, 22·1 per mille; so that the disease was a veritable scourge. The Medical Officers in the station concerned enlarge upon the usual serious aftermath of ear and eye diseases. The writer suggests that with Kaduna within sight as the new capital, and situated in a comparatively cool climate, it should be possible to open a vaccine institute combined with bacteriological laboratories for the Province, and thus get over the difficulty of importing lymph; whilst either Egypt or India should be able to supply the class of Mahomedans required for vaccinators and their supervising staff, as a temporary measure pending further educational possibilities locally.

Altogether, the record of medical work for the year in this Province represents steady advance and foresight as to the requirements of a country undergoing quick-change incident to the process of opening up.

Sanitary Section.—In the process of opening up of Northern Nigeria, the Sanitary Department has necessarily had much of its time, during 1913, occupied in selecting new sites for civil stations and in advising as to their planing. Obviously also, sanitary care of no light nature was requisite along the lines of the railways, now completed and in process of construction. It is satisfactory to find, therefore, that in the hands of so well-known an organizer and administrator as Sir F. D. Lugard, there has been no loss of time in clearly defining the sphere of Sanitary Officers in these important matters, by requiring inspection of each station, in accordance with a ruling which we reproduce under Sanitary Legislation and Rulings. The fact is worthy of attention, as co-operation between sanitary and engineering authorities can be secured solely by definite official rulings. The Sanitary Officer is liable to underestimate engineering, and consequent financial, difficulties in carrying out sanitary proposals and, on the other hand, the Engineer is apt to regard with a light heart flaws in his methods of meeting sanitary demands, that may appear to him trivial, but in the opinion of the Sanitary Officer may render the whole of the proposed expenditure inoperative.

Nothing but cordial discussion between the two experts and the appointment of a final authority—in this case, the Governor—for decision, when a difference of opinion arises, can secure the best results in the public interests. It is in this respect that Sanitary Boards serving direct under Governments often fulfil the desirable function of balancing different opinions.

In regard to sanitary supervision of railway lines, the Sanitary Officer reports that this is carried out by attaching English-speaking Sanitary Inspectors—whether technically trained or not is unstated—to the Medical Officers in charge of the various sections of the Railway, whilst at each main station there is at disposal a conservancy gang, and at each minor station a scavenger.

In an interesting history of sanitation in the country from the period of its occupation, the Chief Sanitary Officer shows how intimately connected sanitation has been in the past, and in future must be with the general progress of the country. The work effected in the short period since the Niger Company ceased operations in 1900 is remarkable. The usual course has been reduction to good order of newly-acquired territory by the placing of garrisons. Medical officers attached to these conjoined their duties to the military with medical help of the native population, and did their best as pioneers of sanitation. Then followed civil medical officers, who were attached to single important stations to serve large areas. These stations were gradually multiplied, and there followed differentiation of medical and sanitary duties as the latter requirements grew in importance. The history is typical of medical and sanitary evolution in all our tropical possessions.

The Chief Sanitary Officer is strong in his belief in the good faith as to sanitary advance of the large Mahomedan population he has to deal with, and repeatedly appeals to the fact that when approached

on the subject in a reasonable and tactful spirit instead of, as he puts it, in the guise of an "understudy of the proverbial bull-in-a-china-shop," they exhibit a full appreciation of sanitary reforms. Indeed, he thus sums up the subject:—"To leave the Mahomedan North and come South, nearly everywhere in Pagan country where sanitary progress is being made—and material progress is being made—it begins in isolated Mahomedan settlements and radiates." Lastly, whilst he by no means counsels ignoring the teaching of sanitation by precept, he insists upon the great principle of teaching by demonstration, by means of actually completed sanitary work, which method certainly commends itself to all sanitarians dealing practically with oriental people of the lower classes; thus he states: "the indigenous native is a most sceptical person, but with him 'seeing is believing.'"

In Notes dealing with the prevention of special diseases, the Chief Sanitary Officer points to the fact that the new Eastern Railway from Port Harcourt will pass through the reputed sleeping sickness area, and holds that the appointment of a special officer in this connection is of urgent moment, on the principle of "a stitch in time saves nine." The danger of importation of yellow fever from the coast is recognized with, however, the statement that up to date, it has never established itself in the Northern Province, notwithstanding locally the presence of favouring factors, and he suggests an "unknown but benevolent *tertium quid*." At present, passengers by road and rail are medically inspected, but canoe traffic, which is large, is regarded as unmanageable in this sense. There must undoubtedly be difficulties; but the danger is so great that we suggest that in the presence of increasing traffic, at least at periods when conditions on the coast point to special fear of incidence, the difficulty should be tackled. So far the mere inspection of travellers (and even here limited to use of special means of transport), can exclude but one aspect of the matter; possibly action against the mosquito by fumigation, as pursued in American fruit ports, might be feasible of local adaptation to certain of the conditions. At any rate, it is well to hold in mind that the chances are always that the "tertium quid" is nothing more solid than the "law of chances."

Formerly, typhoid fever has been regarded solely as the occasional disease of the imported Europeans, but, during the year, 13 cases amongst natives were reported, with one death. Details of this incidence would have been welcome in a Sanitary Report. Taking the facts as stated, however, there is here disclosed a fact that the presence of increasing concentration of the populations upon mines, and centres commanded by railways, affords ground for great watchfulness and, in these particular areas, the early pushing of the usual sanitary measures which protect a population from fly-borne and water-borne diseases.

East Africa Protectorate.*

So largely do physical, economic and climatic conditions differ within the area of the East Africa Protectorate that the Principal

*East Africa Protectorate.—Annual Medical Report for the year ending 31st December, 1912. [Principal Medical Officer, A. D. Milne.] 83 pp. f'cap. 1914. Printed by Waterlow & Son, Ltd., London.

Medical Officer considers that it facilitates a comprehension of medical and sanitary matters to discuss them according to regions, which he classifies as the "Coast Zone," the "Mountainous Zone," the "Desert Zone," and the "Kenia and Nyanza Provinces." Malaria is in varying degrees common to all, but the Gosha District, in the Desert Zone, is alone described as "heavily affected." Some increase is stated to have occurred in the Kenia Province and is ascribed to return of infected labourers from the Coast Zone, and the mosquito-bearing facilities of native water supplies. Filariasis and leprosy are recorded as "fairly common in the Kenia and Nyanza Zone," whilst tick fever has been identified in the Fort Hill District. In the Coast Zone there is no dracontiasis, but there are occasional cases of bilharzia.

During 1912, in a total of 592 European officials in the Protectorate the death rate was 9·5 per mille. In Nairobi, the death-rate in the general European population was 15·8, against 21 per mille during 1911. In respect to the native population registration of deaths only is attempted, and this is confined to townships. The death-rate in Mombasa was in 1912 28·4 and in Nairobi 22·9 per mille.

From a public health point of view, the most satisfactory fact recorded is the diminution of sleeping sickness, as it is now rare for cases to be discovered amongst out-patients at Kisumu, and "with the annual emigration of some 30,000 Kavirondo labourers from the Province, rarer still for an odd case to be picked out from the line."

When, however, progress is looked for in routine matters, it is found that practically no advance has been made since 1912 and, excluding rural areas from consideration, this is applicable to all details in the important towns of Nairobi, Kisumu, and Mombasa—all of which have had plague epidemics. The Principal Medical Officer deals frankly with this state of affairs, by pointing to the slender staff, Medical and Sanitary, at disposal, owing to rapid advance of the country outstripping the present organization; and he looks forward to a better state of affairs after Professor W. J. Simpson's late deputation to the Protectorate by the Colonial Office.

Public Health Service of the United States of America.*

This is an interesting and instructive record not only of work fulfilled in the various States of America and its possessions in the tropics, but of facts of sanitary interest collated in all important ports of the world, affecting trade communications with that country. To gain quick and accurate intimation of disease prevalence, America is not content with Reports from Consuls, but places members of its Public Health Service at chief ports in direct correspondence with headquarters at Washington. An expansion in this direction would seem reasonable by the Empire of India, in reference to the possibility of yellow fever following the new trade routes consequent upon the opening of the Panama Canal. Such outposts would,

*Annual Report of the Surgeon-General of the Public Health Service of the United States for the Fiscal Year 1913.—318 pp. 8vo. 1914. Washington: Government Printing Office.

with telegraph communication at disposal, form a sound first line of defence.*

The following information is abstracted from the Report as likely to be useful in practical hygiene work in the tropics :—

Plague.

In the *U.S. Public Health Reports* for April 1912, Assistant-Surgeon McCoy stated that on the Hamakua coast of Hawaii plague infection of rats existed. But he drew attention to a peculiarity : when the study of the disease in man in this region was undertaken, it was found that all the cases but one had the bubo in the neck. He states :—

" It is well known that when plague is induced in experimental animals by feeding infected material, in the great majority of cases a bubo develops in the neck ; hence, one is justified in suspecting that when a series of cases in human beings occur, in which cervical buboes predominate, we must consider it at least possible that the usual mode of transmission (through fleas) may not have operated in these cases."†

In raising this point, Assistant-Surgeon McCoy has nothing to say against the important rôle of fleas. On this subject the Surgeon-General, after stating that McCoy had again visited the locality (Dec. 1912), refers to the nature of plague found in the same area in 1913, thus :—" Most of the cases present cervical buboes and are of the pneumonic type of the disease." It is hoped that an explanation of this condition may yet be forthcoming, as the Surgeon-General suggests the necessity for the constant presence of a Medical Officer on the spot.

The facts seem to us to point to tonsil infection by contaminated fingers or of cold cooked food, such as might well arise in the presence of infected rats and fleas. We have no figures to prove the fact, but the impression gained during several years' plague inspection work has been that cervical buboes increase in frequency at the period when plague incidence in both the rat and human population is at its height, and is coupled with decreased efficiency of domestic and public general sanitary control. If this impression (formed without any theory to prop up at the time) has anything in it, it would be necessary to regard the average incidence of cervical buboes not during a whole epidemic, but whilst conditions were judged to be as described and at their zenith. On the other hand, it is well known that cervical buboes may predominate in mild outbreaks at the commencement of plague, as in Mesopotamia, and Mettapolliem, Madras Presidency, before rat plague was identified. In this connection, as influenza has no more respect for the tropics than for a temperate climate, it is well that the fact that cervical buboes may be present in certain epidemics of that disease should not be forgotton.

At Iloila, Philippine Islands, a Chinaman was attacked with plague on the 5th July, 1913. He was proved to have been a resident for a long period. No further case occurred till August 18th. Six more cases followed at shorter intervals, the last being in September. " In

* Such an expansion has been recommended by Major James, I.M.S. (see this *Bulletin*, Vol. 3, p. 181 and *Indian Journal of Medical Research*). Ed.

† McCoy (G. W.). A Note on a Peculiarity of Plague on the Hamakua Coast of Hawaii—*U.S. Public Health Reps.*, 1912, Apr. 5, Vol. 27. Pt. 1. No. 14. p. 490.

spite of very extensive rat catching, which was done over a period of five months, no plague-infected rats were found at Iloilo. All the cases occurred in two houses, and there is considerable evidence to support the belief that the plague in Iloilo may have been introduced by bed bugs."

In Manila, a first human case occurred on June 17th, 1913. Rats were caught at the rate of approximately 3,000 per month, but it was not till August 31st that a plague-infected rat was found in a formerly infected block. Up to October, the percentage of plague rats found was only 0·005. Very few dead rats were discovered. In contrast, 13 human cases were found between October 20th and October 22nd amongst labourers employed at the Dagupan Railway Station, and subsequently 17 cases were traced to the same source. The disease was successfully eradicated from this focus by rapid action against rats, which were shown to be infected.

Deratisation.—At San Juan, 50 rodents were killed in ships by fumigation; most of these were obtained from vegetables in crates such as garlic and onions, the dry stems of which were found to afford good shelter. In 1913, in a single ship 154 rats were killed.

As objections were raised to the use of sulphur fumigation for vegetables, it was ordered that hydrocyanic gas should be employed. Rats in cages were used as controls. The result was satisfactory, but in the meantime control experiments with sulphur conclusively proved that objections to it were founded on mere prejudice, as neither in regard to edibility nor subsequent preservation of the vegetables was there any reason to object to its employment. It is not stated what precautions as to human life were taken in using the hydrocyanic acid gas, but the proportion of ingredients employed was, for each 100 cubic feet:—potassium cyanide 1 oz., sulphuric acid 1 oz., water 3 oz. Altogether, 60,000 baskets and 3,000 crates of vegetables were fumigated. In burning sulphur for ship fumigation, the Americans apparently do not require the employment of special apparatus such as the Clayton so much employed on British ships; sulphur is not infrequently burned in open pans, with the precaution of surrounding them with water.

Yellow Fever.

Surgeon J. H. White, U.S.A. Service, was deputed to Jamaica with reference to the opinion of Captain Potter, R.A.M.C. that the "vomiting sickness" of Jamaica was probably yellow fever. After being afforded every facility for the investigation, he concluded that the disease is a "meningitis," on the following grounds:—"It occurs in winter and ceases in the first warm weather; it occurs in the hills and seldom on the coast; it attacks blacks in preference to whites or Hindus; it occurs most often where stegomyiae are least frequent; the interval of time between primary and secondary cases is not sufficient for yellow fever."

Dr. Harold Scott, Government Bacteriologist, Kingston General Hospital, Jamaica, does not consider this conclusion altogether correct; after a large amount of clinical and bacteriological work on the subject, he holds that "though cases of meningitis occur amongst those reported as 'vomiting sickness,' the two diseases are

not identical. After the former have been included, a large proportion still remains unaccounted for, so far as actual knowledge of the cause goes at present."*

Dr. AMES in inspecting Guatemala City found Stegomyia at the altitude of 5,000 feet, which fact may be read in connection with one of Surgeon White's findings just mentioned.

Surgeon White inspected the fruit ports of Belize, Livingston, Puerto Barrios, Puerto Cortez, Puerto Limon, Bocas del Toro, and Almirante. He considers that the British port of Belize is in an exceptionally good condition, and that the quarantine method against yellow fever is sound, with however the exception that " anti-mosquito work is needed." This reference to connection of fruit ports and yellow fever transmission ends with the following statement, based upon eight years' familiarity with the coast concerned—" that the greatest risk of infection by far is *via* the Guatemalan Railroad, and not by sea, and that the infection of one of these northern fruit ports may, and probably will, result in the infection of all, and therefore it would be well to watch them the whole year round."

Of the notorious port of Guayaquil, it is reported that " owing to the screening of the hotels, the number of cases of this disease amongst the foreign population has been considerably less than in former years."

Ankylostomiasis.

At San Franscisco, all oriental aliens are examined as to various health and other conditions, under the American Immigration Law. Of 13,383 examined (nationality not stated) 1,888 cases of ankylostomiasis were found. It is held that, whilst in regard to the white races the general appearance as to anaemia and lassitude arrests attention, the microscope should invariably be used for oriental cases, as the usual constitutional symptoms were not demonstrable, there having been detected " infection in people with unusually good physique and healthy appearance."

**Reports to the Advisory Committee for the Tropical Diseases Research Fund*, 1913, p. 171.

DISEASE PREVENTION.

Malaria.

Malaria in Bengal.

Bengal has at the present time a population of 46,305,642 and an area of 84,092 square miles. If the exceptionally large urban area of Calcutta and its suburbs be excluded, 96 per cent. of the people live in villages. There are 124 towns with populations exceeding 5,000 inhabitants. The average village contains about 352 persons. 77 per mille of the population is literate, and there is a primary school for every three square miles. Except within the Municipalities, where an organisation is already sanctioned, there is no executive sanitary staff. 34,937,572 of the population depend upon agriculture for their support. The corrected death rate from all causes, as deduced by Mr. Ackland for the Board of Trade, was for the decade 1901–1911 not less than 40 and, probably, 48·7 per mille. The death rate from "fevers," as registered by an indifferent agency, was 21·16 in 1912.

The land is delta under formation in parts, especially towards the east and south, and is in a more or less completed formation towards the west, as a result of deposit of silt derived from the water of the Ganges, which is distributed by minor rivers through the delta. Both the mother river and the distributory rivers are subject to changes of direction. In the latter there is a tendency for silt to so accumulate above the original beds that ultimately they become higher than the average level of the country, and, when not restrained by embankments, lead to dangerous floods in villages. Much of the total land is in normal circumstances flooded at the height of the rainy season; and, in recognition of this fact, villages are, as far as possible, placed on available hillocks. In the north the elevation of the delta is 70 feet, and in the south from 10 to 20 feet above sea level.

The following is a description of the average village, as given in a Report* of the Jessore District by Captain Stewart, I.M.S., and Lieut. Proctor, I.M.S.:—

"The majority of the villages in the District consists of a number of separate homesteads scattered over a large area, each homestead being occupied by several members of the same family. The houses are built of split bamboos raised on a mud plinth of varying height, and in close proximity to the dwelling-houses are the sheds for cattle, the houses and sheds usually enclosing a central courtyard. The whole village is embedded in a dense tangled mass of jungle and bamboo thickets, and through this run numerous paths winding in every direction. Beneath the thick

* Stewart (G). and Procter (A. H.) Report on Prevalence of Fever in Jessore and Murshedabad Districts, India, 1907; embodied in *Report of the Drainage Committee, Bengal Presidency Division*, 1907. Calcutta: Printed at the Bengal Secretariat Press.

undergrowth round each house lie countless numbers of pits, from which earth for the plinths has been dug ; during the rains and for long afterwards these are stagnant foetid pools, full of rotting leaves and vegetable matter. No sun reaches them, so that evaporation is slow, and they remain for months in convenient places in which the female mosquito, heavy with her latest feed of blood in the neighbouring house, can lay her eggs, and swarms of larvae find ideal surroundings for their growth. The adult mosquito, too, finds shelter during the day from sun and breeze in the shade of the jungle round the houses, and the more domestic species obtain a resting place undisturbed by smoke in the cowsheds alongside. To the inhabitants the jungle affords privacy in their households and probably some protection from cold breezes in the winter, but it is also a convenient latrine and the stench in some of the villages is overpowering. The drinking water supply is generally extremely bad. Villages on a river take it directly from the edges, generally at a spot which is used as a bathing ghat, whilst the banks in the close proximity are made use of as a latrine. . .

"The rivers and tanks from which drinking water is obtained are also often used for steeping jute. . . . . This extremely insanitary condition is combined with a general water-logging of the soil, shown by the high level of the subsoil water where it could be estimated, and by the innumerable marshy tracks and bheels [lakes or marshes] scattered all over the country, and it is to the combination of the two that the extreme prevalence of malaria may be attributed."

As to the economical and social condition of the people, the ryot [farmer] has become, with the passage of time, well-off in view of the steady rise of prices of rice and jute. The labourer population is, however, readily adversely affected by failure of rainfall or other conditions upon which agriculture depends. Every hundred ryots employ, on an average, 12 labourers.

The three Districts chiefly affected are Jessore, Nadia, and Murshedabad. Their previous history shows that, though malaria underwent aggravation at the time of the Burdwan epidemic, it had existed in 1770. The total area of Bengal held to be markedly malarious is chiefly comprised in the districts mentioned, and is estimated at 5,780 square miles. Within the more or less malarious tracts about 1,973,800 acres are under rice cultivation.

In response to public opinion the Government of India, in 1906–07, deputed Captain Stewart, I.M.S. and Lieut. Proctor, I.M.S. to make a special Report on malaria conditions, which was to be considered by a Drainage Committee, consisting of one officer of the Indian Medical Service (Lieut.-Col. Clarkson), Mr. W. A. Inglis, of the Public Works Department, and Mr. H. Wheeler, of the Indian Civil Service. This was followed by the deputation of Major A. B. Fry,* with the object of extending the enquiry of his predecessors on certain points. It is to the Reports of these authorities that we refer in discussing this subject.

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* Fry (A. B.) (i) First Report on Malaria in Bengal.— 42 pp. + v. pp. f'cap. With 10 maps, 11 charts, and numerous tables. 1912. Calcutta: Bengal Secretariat Book Depôt. (ii) Second Report on Malaria in Bengal.—37 p. f'cap. With 4 maps and 2 charts. 1914. Calcutta: Bengal Secretariat Book Depôt.

The first task in investigation in dealing with vital statistics, which necessarily rely upon diagnosis (or artificial memory processes) by village servants, was obviously to differentiate death causation under unclassified "fevers," so as to ascertain how far malaria is responsible for mortality. Fry gives results of enquiries into clinical histories of cases, as conducted by Asst.-Surgeon Mithilies Chandra Ghosh, in Dum-Dum thana, for a typical rural area. He shows that 36 per cent. of "fever" deaths were probably due to malaria, and that these constitute 24 per cent. of the total mortality.

Using the spleen rate as the test of the endemic and hyperendemic areas, Fry and his assistants examined 1,082 villages and 42,580 children. In the 24-Parganas the rate varied from 17·3 to 84·5; in the Nadia District from 70 to 83·8; in the Jessore District, from 17·3 to 84·5; and in the Murshidabad District from 44 to 90·6 per cent. Whilst acknowledging the existence of kala azar as a possible cause of the splenic enlargements, he holds this disease to be sufficiently small in prevalence to be negligible, in this particular connection. In Jessore, the endemic index varies from 20·8 to 36; in the 24-Parganas from 8 to 33·3, and in Murshidabad from 16 to 46·1. The "spring" fever mortality rate reaches its apex in April, followed by a decline; a winter increase occurs in September, reaching its apex in November, that is, coincident with the cessation of rain; the period of least mortality from fever is held to be June or July. The rains commence in the second week of June and end in the last week of October; in the area under discussion, the total average rainfall is about 63 inches. The remaining months are "dry." In this connection we may quote a lay author, who states that the rice fields "in Bengal are moist till September, begin to dry up in October, and by April and May are quite dry and cracked." The following is a list of mosquitoes identified: —*Nyssorhynchus fuliginosus*, and variety *adiei*; *Nyssomyzomyia rossii*; *Myzorhynchus nigerrimus*; *Neocellia fowleri*; *Myzomyia culicifacies*; *Myzomyia listonii*; *Myzomyia albirostris*; *Myzorhynchus barbirostris*; *Nyssomyia rossii*, variety *indefinata*. Of these, Fry states:—

"The commonest is the *N. fuliginosus*, which exists in greater numbers than all the other species put together. It exists in enormous numbers during the autumn and winter months, and remains numerous up to the end of January. The numbers gradually diminish through the hot season. It does not begin to increase until late in the rains. In September an increase begins, progressing steadily until the enormous winter population is fully established in November. The favourite resting place for adults is the roof of cow-houses, in which they swarm, and I have counted as many as 60 on a single cobweb."

Proctor and Stewart kept the question of subsoil-water level in mind in respect to its favouring the production of pools and, consequently, mosquito propagation. They were, however, unfavourably situated as to reliable information. Their conclusion was that "the high spleen rates do not correspond with the tracts of country having the higher sub-soil water after the rains." They founded this on the fact that whilst in 43 villages in the Murshidabad District the average level was 2·7 feet from the ground, in 4 thanas [small administrative areas] where the spleen rates were higher the average sub-soil water level was 3·6 feet,

and in two thanas, where the spleen rates were lower the average subsoil level, in twenty villages, was only 1·4 feet. The Drainage Committee, in remarking on these results, states :—" The general connection between the prevalance of malaria and the height of the sub-soil water is deserving of further investigation than it has yet received in Bengal. Captain Stewart and Lieutenant Proctor have endeavoured to collect some data, but we do not consider that great importance can be attached to them. They were necessarily not based upon accurate and regular observation." . . .

The Drainage Committee classify Proctor and Stewart's results connecting malaria prevalence with physical features of the country as follows :—

Situation.	No. of villages. examined.	Average spleen Rates.
On dry land	45	45·6
On live rivers	33	46·0
On bheels	56	62·2
On dead rivers	38	64·5
On flushed bheels	36	66·0
On unflushed bheels	7	79·4

Fry's investigation was inspired by the requirement to get further proofs of the facts thus brought together by the Drainage Committee from information supplied by Proctor and Stewart; but the whole tendency of both his Reports is to show that his personal experience is that, granted the presence of an efficient mosquito and the human gamete carrier, local conditions as affecting increase or inhibition of mosquitoes are of little import. He would deduce from his own observations a ruling " that when the human infection rate reaches a level which is measured by juvenile spleen rate of 30 to 40 per cent., then the number of recoveries exceeds the number of new infections and malaria dies out automatically, and with progressive rapidity." He supports the theory by no figures applicable to such a deduction, but alludes to a mathematical calculation by Ross (" The Prevention of Malaria," Second Edition ; Sect. 28 and 66).

Whilst the formulae referred to take cognizance of conditions as found in a locality at a certain period, it is not apparent Ross would desire to ignore variable physiography, meteorology and movements of populations acting and re-acting upon malaria spread, and to lay down a law as to the limit of remedial measures, in an area of 84,000 square miles. Yet Fry's arguments lead him to insist that the " most important antimalarial measure is to reduce the number of human carriers by quinine, and that a certain point will be reached when the human carriers are sufficiently few for the number of recoveries to exceed the new infections, and then the progress to zero will be automatic and rapid."

Fry's theories are based on the supposition that he found, in the south of the Howrah District, a line of country which did not differ in physical characteristics from the hyperendemic areas—yet was not malarious. He discovered that " in the Presidency Division the *N. fuliginosus* is in vast preponderance, but in the Howrah District, though *N. fuliginosus* is very common, yet *N. barbirostris* and

Myzomyia form half the anopheline population." . . . Throughout the investigation notes were made of physical conditions. From these and my own observations, I can assert that the southern part is more swampy, more jungly, and has just as many mosquitoes as the northern part, and in no way can the absence of malaria be attributed to improved environment of the villagers." Surely a condition that was "more swampy and more jungly," and was more favourable to one species of anopheles (the *M. culicifacies* being certainly a potential carrier) in a different part of the country, meant a change in character or configuration of soil or subsoil, and of surface and subsoil drainage, and could not reasonably be ascribed to similar physical conditions. Had he ascertained what these physical conditions were, there would have remained the problem of importation of the human malaria bearer in connection with the favourable or unfavourable factors here linked together. Further, so long as births continue in a malarious district, and thus new juvenile subjects are provided, the automatic dying out of malaria he contended for must be a remarkably long process. Indeed, if this does occur, a depressed birth-rate is more likely to figure largely in the process than immunity being acquired by adults automatically at a certain rate of juvenile infection. A branch of the law he would lay down is thus stated :— "Endemic malaria does not establish itself by slow propagation but must be preceded by epidemic conditions." This is a wide deduction, which seems but little to merit the word "must." He himself quotes the case of a family at Daharpur who have suffered severely from malarial fever within a malaria free area, and, in the assumed absence of epidemic conditions, he makes no remark showing he regards their presence as of any danger; yet, when he inspected the village of Rajnagar, quoted by Proctor and Stewart as an instance of a village free of jungle and possessing but 11 per cent. of spleen enlargement, Fry found, when after some time had intervened he personally examined the inhabitants, that the spleen rate had increased to 24 per cent. This he accounts for by saying "proximity [of the village] to and connection with its two unhealthy neighbours appears to be gradually increasing the spleen rate." In another locality he speaks of malaria in its gradual spread as behaving "like a contagious disease." Indeed, there are plenty of areas where malaria has gradually increased in intensity, nor are epidemics always followed by severe endemic conditions. Thus, in the area along the Cauvery and the Vagai, in the south of India, which is always a ready example of an irrigated yet malaria free country, there occurred in 1809–10–11 a malaria epidemic as severe* as the notorious epidemic of Burdwan. It followed unprecedented rainfall, causing new but temporary disturbance of surface and subsoil drainage which, in the light of present day knowledge, presumably influenced mosquito propagation. Malaria disappeared at the end of two years, consonant with relief of surface and subsoil waters.

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* The mortality of human beings was so great that in many places the crops could not be cut for lack of hands. Chiefly from absence of men to care for them, 44,273 cattle died.

When these statements are considered side by side with the fact that though he was able to prove that *N. fuliginosus*, though sparsely found in human habitations (but plentiful in neighbouring cow-sheds), is an efficient carrier, it is a foregone conclusion that he sees no hope for Bengal, beyond the use of a quinine campaign. Consequently, much of his Report is taken up in the effort to show that "as the natural features of Bengal do not lend themselves to schemes for mosquito reduction, which is the ideal of a malaria prevention campaign, we must endeavour to lessen the incidence of the disease by attacking other factors, so as to reduce the disease by effective treatment of the chronic cases."

Although we consider that the data collected by Fry do not justify this extreme deduction, as applied to not mere localities but a whole province, they are yet of value in securing exclusion of one of the physical conditions concerned, so as to clear the way for application of remedial measures.

Before, however, we utilise this process of exclusion, we would, in agreement with the Drainage Committee, when treating of subsoil water-level, state that the information available from which we draw inferences is exceedingly scanty. We believe that this failure is to be found not in the stinting of labour by the medical officers furnishing the Reports, but in the manner of their conducting it. We hold that it is largely a waste of labour for a sanitary officer to attempt a sanitary enquiry in the tropics connected with malaria prevention, water supply, disposal of waste, or town planning, without being provided with an engineer subordinate absolutely at his disposal. The class of engineering skill required to assist the sanitarian in the enquiries is not great, and merely implies that if he wants to test the character of a subsoil, ascertain a subsoil water-level, measure a flow of water, find the gradient of an area, make approximate estimates to judge of their feasibility or express his requirement of buildings on a plan, he need not supply the muscle and time to secure his data, provided he be capable of giving directions and checking results.* In the absence of this aid, both Proctor and Stewart's and Fry's Reports are defective in the important requirement of connecting their physical data with their malaria investigation. These officers were provided with Assistant Surgeons and Sub-Assistant Surgeons *ad libitum* in an enquiry which extended from 1906 to 1913, but the essential class of help which would have rendered their Reports definite has been absent, although, in Bengal, a Public Works Supervisor could have been provided at Rs.250 per mensem, or an Overseer at Rs.50 per mensem.

The Relief of Surface and Subsoil Waters.—Fry devoted attention to the question whether it would be advantageous to drain a large bheel known as the Arool. The object of the proposal (which was not initiated by him) was to flush the dead upper reaches of the Bhariab river. Obviously, the mere flushing of this river would not influence malaria much, and as there is a concurrence in the Drainage Committee's Report with this view it need not be discussed. He

*Under "Sanitary Rulings," is quoted a Madras Government Order showing that this principle has been long recognised by it.

was able to show that, in comparison with the rest of the country, the surroundings of the bheel were not more malarious—which, by the way, was in itself a small mercy -and he certainly proves that towards the interior of the bheel the spleen rate was diminished. But Fry forgets to state that, in Bengal, there are bheels *and* bheels, and the following quotation from the Drainage Committee's Report will show that there are differences which suffice to exhibit the influence of continuous sheets of water as compared with marshy land :—

> "It cannot be said that bheels which approximate to lakes are probably detrimental to health. They never dry up, leaving large areas of shallow mosquito-breeding pools, and they may be useful reservoirs of drinking water. The charge is rather against the swamp which has either never been drained, or which at one time used to drain more quickly than it does at present." . . . . "If the water level in the bheel, by efficient drainage, fell quickly, the surrounding country draining into the bheel would dry more rapidly ; hence collections of surface water would be found existing for shorter periods, and fewer facilities would be offered for the breeding of mosquitoes."

It was of course a familiar fact in past years that the covering of large areas with permanent sheets of water abates malaria—a fact in the present day explainable with reference to the edges alone being suitable for mosquito propagation. As a modern instance of successful application of this method we may quote Bhamo in Burma, and more remote instances in the case of the lakes of Bracciano, Bolsine and Trasimeno.

Now we think the contrast drawn by the Drainage Committee as to permanent sheets of water and marshy land points to the possibility of a definite line of action, as to relief both of surface and subsoil waters within the hyperendemic areas.

In the course of delta formation a typical silt contributory stream from the Ganges must, at its origin, pursue a course from a higher to a lower level, and must plough existing alluvial deposits in forming a bed ; the trend of the surface soil being ordinarily that of subsoil waters, its sub-streams would be supplied by the pre-existing subsoil waters of the neighbourhood ; if the stream cut deeply into the alluvial soil, in making its bed, it would, by extension of the drainage cone, fulfil all the usual functions of a river as a subsoil water recipient from an extended area. But, in time, the new-formed river would accumulate silt in its bed, which would tend to deflection of the current in new directions ; and given a state of seasonal small volume and low velocity, the silt would cause inflow to be arrested, or diverted at certain points, especially in respect to clay particles and manner of deposit, if tending to choke the soil interstices (voids) within the limits of the incoming subsoil water. As time advanced deposited silt would cause the familiar raising of the bed level, but below this the old sub-stream (subsoil) water would still pursue, in the main, the course of the old trend of the country, although here and there deflected. Under such conditions, in a country enclosed by two parallel rivers, running at right angles to the trend of the country in its later formation, there may occur comparatively water-tight compartments. In illustration of such varied conditions, resulting in delta land, we may state that we have seen rivers with sub-streams within a few feet of each other

vertically which were brackish and sweet, respectively; and that a dead river course hidden within the subsoil, with its still living sub-stream, could be so closely defined that brackish water could be obtained immediately outside the bed within which was sweet water. As a further advance in formation of the typical river we have traced, silting would become so complete that at certain spots a "dead" river and, later, an interrupted course would result, with here and there a depression unfilled with silt; whilst, in other parts, the river bed would be so raised by accumulation of silt above the general level of the country that, by overflow of its banks, older depressions at lower levels would be more or less abolished by silt. By such additions from distant sources of silt and by local attrition by rainfall, the course of old dead rivers must be gradually obliterated. Great depressions might however remain unfilled, and, *where these represent old river beds*, not only would the influence of the subsoil water be more readily evident within them, but, as spots below the level of the surrounding country, the reecipt of surface water would also be favoured. We suggest such depressions are the *permanent* "bheels."

In referring to the delta, the Drainage Committee give the following opinion as to the direction in which formation has proceeded. They state:—

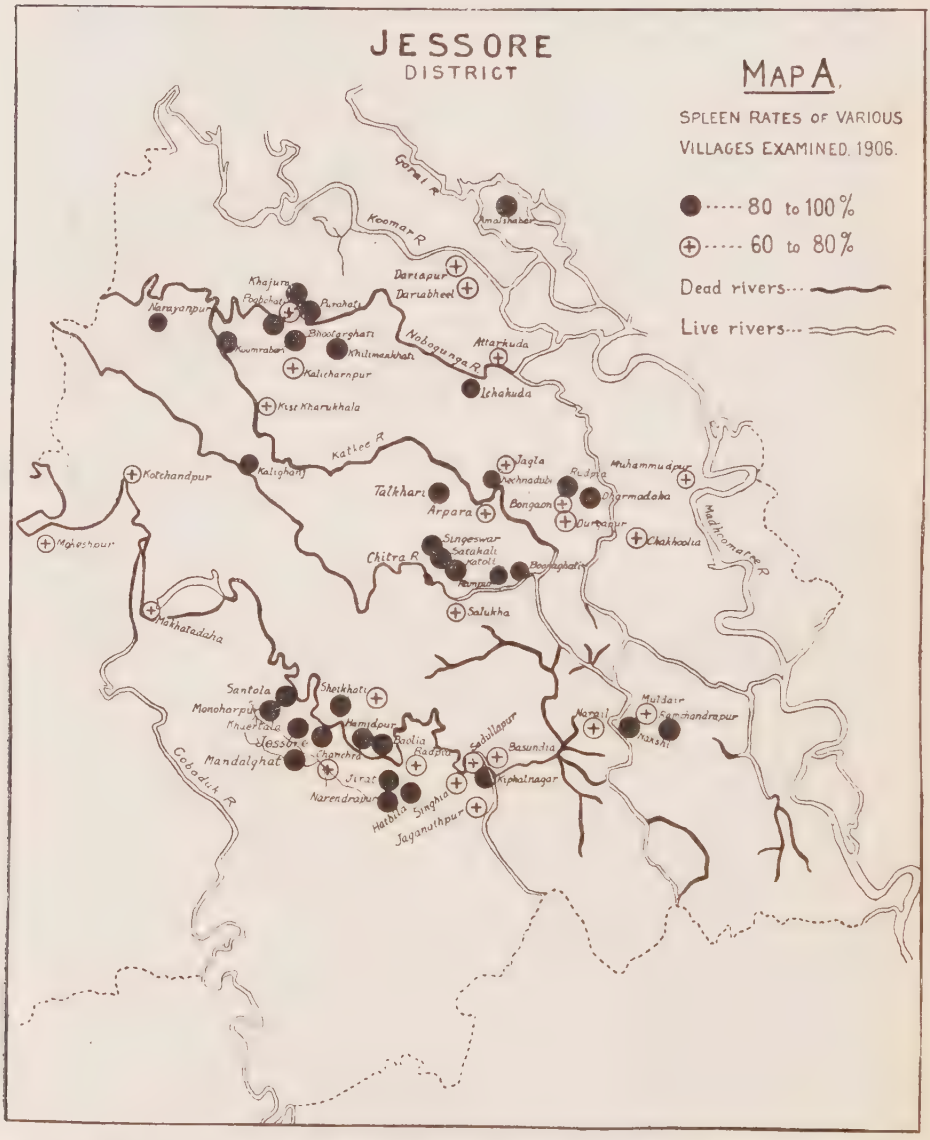
"These four channels constitute the main arteries traversing the whole tract from north to south from which so much of the water of the Ganges flows as does not proceed down the Padma towards Goalundo. Between these arteries are various distributory streams, running generally from the north-west to south-west (*although the direction is now the reverse on the eastern side of the Jessore District*), but in some cases tending in a more southerly direction. . . . . The process on the western side is now more or less an accomplished fact; on the east it is in progress, and in the centre it is gradually increasing." [Italics not in the original.]

We thus enter into details, because we think they demonstrate the possibility of utilizing practically the Drainage Committee's division of bheels into those of mere marshy land and those of permanent sheets of water, as well as their opinion as to there being a general subsoil water level of the country, but accompanied by interruptions of water-tight tracts. We would argue that, in an area where Sir Alexander Binnie's datum* for a similar country as to evaporation from water is not likely to be less than four feet in the dry season or five feet *per annum*, these permanent bheels fulfil the useful function of *conveniently exposing subsoil water bearing strata*—otherwise their permanency would be out of question. Similarly, Fry's statement that "all tanks and most borrow pits contain water all the year round" would show that, over large areas, either subsoil water is exposed at shallow depths, or its influence by capillarity on soil, by reason of proximity to surface level, is sufficient to readily favour complete saturation in the presence of additions by surface flow.

If these arguments be sound, a definite policy is feasible in respect to the markedly malarious triangular area between the Bhagirathi River, Ganges and Gorai Rivers, within which is situated the Jessore,

* Binnie (Sir A. R.). "Rainfall, Reservoirs, and Water Supply." 1913. London. Constable & Co., Ltd., Publishers.

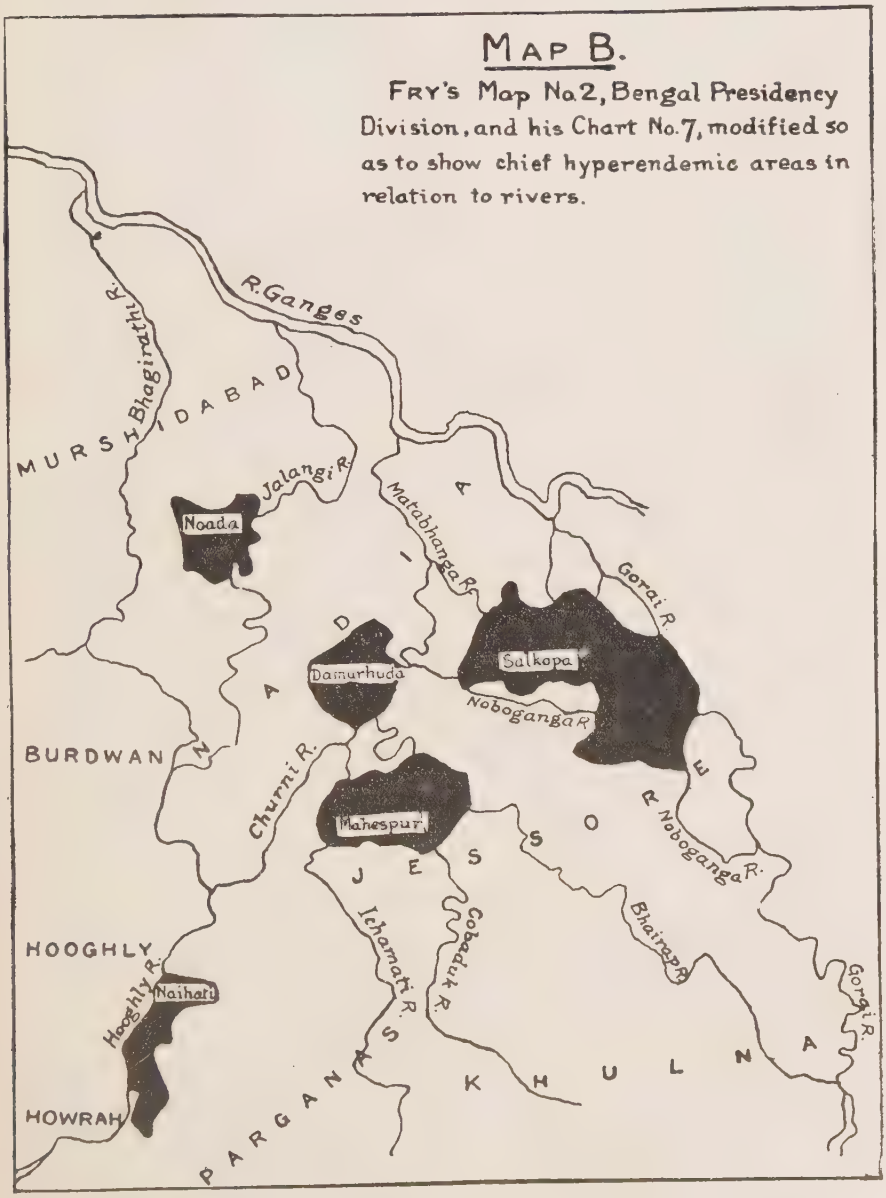
Nadia and Murshidabad Districts. In this country, as shown by the maps given by Proctor and Stewart (Map A), which we reproduce



PROCTOR and STEWART'S Map of Jessore District, showing relation of spleen rates to dead and living rivers, modified so as to exclude rates below 60.

modified as stated thereon, the influence of old dead rivers running at almost right angles to the present trend of the country to the south is obvious. As another test, we would state that if a diagonal line be drawn through Fry's original map No. 3, giving spleen rates, (on which he relies to show that neither dead nor living rivers have

any influence on results) so as to pass through the dead river areas, the spleen rate is found to be, on an average, 73, against 55 along the east bank of the Gobaduk—a river partly dead, but which has a south trend, and, therefore, serves an area where interference with the original subsoil water flow is less likely. Again, in Fry's map No. 7, the same fact is evident on the east bank of the Bhagirathi River. But the Naihati-thana stands out as a small and, in this sense, useful



exception in our modified Map B as conspicuously malarious—notwithstanding the service of the Hooghly, a living river. We suggest the chances are here that, irrespective of obvious surface obstructions to which the Drainage Committee calls attention, there is an obstruction of subsoil flow from this area by a compact silted bank. Whether this be the case or not, the ease with which the place can be supervised from Calcutta and the danger of spread of malarial fever from this focus in that direction, seems to us to dictate that the Drainage Committee were right in advising attention to this area as one of the first that should be dealt with. Similarly, although they conceded efforts had been made in the matter, there was sound ground for their recommendation that further enquiry should be made as to the perfection of drainage in the embankments of the Central Section of the E.B.S. Railway, which, to the south of Jessore, runs at almost right angles to the trend of the country.

Ordinarily, bheels are recipients of drainage from the rice fields and villages *en route* to rivers *via* "khals" (artificial or natural channels). In this they probably fulfil the excellent function of balancing reservoirs, and thus prevent floods. Where removal of obstruction in khals would not sufficiently lower the water level of bheels for effective surface drainage of an area, it is evident that this could be effected by pumping, with the object of not only making sure of relief of surface water but, *in the case of khals of a permanent character*, of depressing and maintaining, at a predetermined point, the subsoil water. Incidentally, a considerable part of the 256 square miles of bheels would be rendered available for cultivation, and therefore yield some compensation for capital sunk; and, as the Drainage Committee remarked, the water might be available for domestic water supplies of villages. Further, they might provide water for irrigation for second crops, in the presence of correct measures for removal of surplus water, as the total lift to command the land would rarely be great. Were several such permanent bheels selected, there would be established pumping centres for subsoil and surface water relief distributed, as far as possible, on a radial system, so as to affect a wide area of country In this manner could be fulfilled the *desideratum*, as to which the Drainage Committee, Proctor and Stewart, and, probably, Fry agree, that a system is required which will remove, rapidly, in November, surplus moisture after completion of rice crop cultivation.

The system we suggest would particularly meet the possible existence of water-tight compartments of country and might well be a preliminary to large drainage works, because it would define the limits of the utility both of drainage channels and of pumping.

So far, in the 24-Parganas, drainage channels have been made or are contemplated which largely follow the contour of the country. In the hyperendemic area of the older delta formation, however, drainage would be required on much more seriously developed lines, so as to tap the subsoil water. The problem of attaining this end is one of local financial and engineering interest, in which we suggest the Bhairab river, or the line of country it pursues, would inevitably figure largely in fixing a main channel.

The idea of pumping Bengal bheels must, when the Drainage Committee wrote their Report, have been considered Utopian, and was therefore not entered into ; but, if Lord KITCHENER has concluded that the Humphrey pump places at disposal a sufficiently economical method of drainage in Egypt (in delta land), their employment in selected areas in Bengal should not be regarded as absolutely unreasonable. For Egypt eight Humphrey pumps, *plus* two in reserve, have been ordered. The eight will discharge per day 792 million gallons with a lift of 19 to 20 feet.

In regard to the khals, which under any system would have to be carefully cleared of obstructions, the use of bheels for pumping centres would have the advantage of little necessity for diversion of the present routes to rivers, or of surface waters from villages and fields to bheels.

For the rest, the problem of surface drainage must be connected with village administration, in the direction of preventing obstruction to outflow by routes where there are vested interests, and getting finally rid of careless water-spread. Such matters would best be in the hands of the Sanitary Department, whose executive staffs should have sufficient sanitary engineering knowledge to estimate for and, in minor cases, execute necessary petty works in consultation with revenue officers ; leaving the major works to specially qualified engineers, such as the Public Works Department of India is richly provided with.

In connection with the complicated problem of drainage in combination with irrigation on village sites, BAIRD SMITH, as far back as 1855, in respect to the Punjab, suggested that the correct way to prevent petty opposition was to secure the influence of a co-operative system amongst agriculturists, which, as it happens, has already made a fair start in Bengal, and should therefore prove a useful ally to sanitation, in acquiring amongst cultivators a mutual regard for both public and private interests ; for, as Lord CARMICHAEL, Governor of Bengal, recently put the matter in a public speech, the question which is at the root of the malaria problem and irrigation, is not solely how to get water on to the ground, *but how to get it off*, after it has fulfilled its agricultural function.

"Jungle" and "Bush" Clearing, Drainage, or Both ?

In connexion with Bengal malaria, the question of efficacy of jungle clearing has arisen. In our tropical colonies Sanitary Officers appear to entertain no doubt as to the advantages of the method owing to exposure of concealed pools to sun action ; nor did GORGAS in Panama nor WATSON in the Malay States fail to use the method in this sense, as an adjunct to other malarial measures. The Government of Burma for many years made grants for "clearing of jungle" round Katha and Myitkyina, with good anti-malaria results. The following opinion was expressed by the Royal Commission (1859) on the "Sanitary state of the Army in India" (p. 169) :—"Nothing is more likely to prove advantageous to the climate of the Indian environment than the clearing away of jungle, the draining of useless swamps and an extensive cultivation of waste land."

Watson showed in 1911* that from the placing of coolies' barracks in open land at certain distances from undrained jungle very decided benefit resulted :—

Distance from jungle ..	300yds.	300–600yds.	600–1,000yds.	Over 1,000yds.	Total.
Number of children ..	325	396	532	1,042	2,295
Spleen Rate	47	21·9	11	2·6	14·2

Fry gives the following instance of inhabitants moving from jungle encompassed villages to open ground :—

† " An examination of spleen rates in these new hamlets produces some interesting facts. At the southern edge is a Mahomedan section of about thirty houses, which was built about twenty years ago. This is fully open to sun and air, but touches the jungle behind, and is close to the broken soil and tanks. The spleen rate is here 57 per cent. At a distance of 150 yards from this is a Hindu section of 40 houses. This is about five years old, and is absolutely free of vegetation. The spleen rate is 23 per cent. To the north is another hamlet of oil pressers. Seven years ago they moved bodily away and built a small village in the open at a distance of one mile, and though they still cultivate some of their own land they seem to have got completely away from the fever. The table below shows that spleen rate falls in direct proportion to the completeness of removal :—

25	children in	old Oosta	Spleen rate	96	per cent.
17	„	of a village on edge	„	59	„
19	„	„ 200 yards away ..	„	23	„
12	„	„ 1 mile away ..	„	0	„

The Bengal Drainage Committee in their Report on Malaria in Bengal, in 1907, quoted instances of drainage works which had been undertaken by Government in the Howrah District many years previously, and had undoubtedly been followed by improved health of the areas concerned, as contrasted with those neighbouring on them where no such measures had been undertaken, but they could only appeal to statistics showing decline of total mortality without differentiation as to malaria. Perhaps, however, the most recent testimony to the efficacy of surface and subsoil water relief (as an indirect effect of sewerage) is that referred to in the Calcutta Corporation Report 1909–'10. In that year, a syphon had been placed under Tolly's nullah with the result that, in the opinion of the Committee, it was " worthy of special note that in the areas in which the sewers had been completed, the morbidity from malaria had fallen considerably and health had greatly improved."

In 1864, in giving evidence before the " Epidemic Committee," Babu Degumba Mitter quoted a good instance in which the removal of obstructed surface drainage in the immediate neighbourhood of the village of Dwarbaswimy proved an effective anti-malarial measure. He said that the zemindar " at a cost of Rs.120 drained a bheel to the north-east of the village into a khal, and thus into the Kadernully River." The zemindar thought that the " bheel would have a central pool which would not dry up after the drainage," thus vindicating the Drainage Committee's subsequent classification of permanent and marshy bheels. This forecast was duly realized, and it is stated

*Watson (Malcolm). The Prevention of Malaria in the Federated Malay States, 1911. Liverpool School of Trop. Med., p. 65.

† (Second Report on Malaria in Bengal, p. 16.)

" no fresh infection occurred." The sick " were only those . . . . labouring under old fever and enlargement of the spleen induced by chronic disease." The chief official of the district of the period, Mr. MONTRESSOR, had used jungle clearing in the same area however, and was not disposed to let drainage have all the credit, so that he reported officially " the benefit that has resulted from these improvements in drainage though unquestionable has not been such as to induce me to attribute to defective drainage alone the prevalence of sickness at Dwarbaswimy." Those who espoused drainage were disposed to regard praise of jungle clearing at its expense as due to personal bias, but, in the present day, with knowledge of the mosquito as the transmitting agent of malaria, there can be no doubt that Degumbar Mitter, as reported by " The Hindu Patriot " (of 1874) was right in insisting upon the prime value of drainage, whilst Montressor was correct in holding that jungle clearing was an adjuvant; that is, that so long as there are pools of water suitable for mosquito breeding, " jungle " (using the term to include miscellaneous undergrowth) would impede the drying action of the sun, and would afford suitable day shelter and shade for mosquitoes bred in the pools. To suggest mere clearance of jungle from land so waterlogged that the sun's action is insufficient to secure rapid drying, is a procedure exceedingly feeble in proportion to expenditure involved. Indeed, all that may result, as has occurred in the experience of Mr. EVANS, Executive Engineer dealing with anti-malarial works in the neighbourhood of Kuala Lumpur, is an increase of anopheles of one species and decrease of another, presumably as a result of alteration of environment; a fact that would fit in with FRY's contrast of conditions in the South and North of the Howrah District, if he would admit that an area " more swampy and more jungly " has determining physical features.

Obviously, the necessary corollary of jungle clearing is evaporation, under increased sun action, of surplus moisture for mosquito breeding. A striking instance of the influence of dry ground, in the midst of the malarious areas of Burdwan, was thus reported by Mr. METCALF, I.C.S., in 1862. He stated that " Belam, in the Bood-Bood circle, stood in the midst of epidemic tracts with all its inhabitants healthy, no death, no chronic sickness, no misery; in every household the people breathing the same atmosphere as thousands of their fever-striken fellow-creatures, and the sole perceptible difference is that the village is drier," (" The Hindu Patriot," 1872–'73).

In Bengal, according to Fry, the offer to clear the neighbourhood of villages of jungle has been met by agriculturists with either apathy or talk of compensation. In this the inhabitants must have reverted to the unpopularity of the measure in 1868, when the Government of Bengal reported to the Government of India that " no permanent good followed jungle clearing, as growth is just as luxurious two years after."

There are doubtless landlords open to secure jungle clearing not as a single measure but as a concomitant of drainage in Bengal villages, when, by a careful dissection of vested rights, the giving of compensation where this is just, and assigning special land for growth of fuel supply or other facilities, the villagers may be afforded ocular *demonstration* of the advantage of anti-malaria measures. In the

meantime, it is a somewhat remarkable fact that Hindu villagers, in their eagerness for gain by irrigation up to their doors, have forgotten the salutary requirement of Manu, which demands a zone for pasturage (not of miscellaneous "jungle") of 200 yards round a village and 600 yards round a town -a ruling of no small importance where malaria is rife.

Similarly, in the matter of planting trees for monetary gain (under the plea as reported by Fry that certain are "sacred") as well as in diverting or obstructing water-courses, which are factors in malaria prevalence, they forget the unsuitableness of persons who do such things to attend ritual feasts (Sradhas).

Silting in Malaria Prevention.

Sir Edward Buck has recently done good service in pointing to the importance of control of rivers bearing silt, and the advantages to agriculture of deposits so brought about. Dr. BENTLEY, in the interests of anti-malaria efforts in Bengal, carries this argument a step further. On recent delta land in Eastern Bengal, he pictures the absence of malaria and profitable agriculture amongst the healthy and increasing people, whereas, in Western and Central Bengal—the area of dead rivers with which we have dealt in a preceding note in this issue—he finds the absence of silt-laden water in a country protected from floods by artificial embankments and, in consequence, impoverished soil, malaria and a poor and dying people.* According to Dr. Bentley, therefore, the remedy is simple —flood the land with silt, and malaria will disappear, the land will bear rich crops, the people will be healthy and prosperous. Finally, in confirmation of his opinion, he appeals to the experience of Italy. As a sequel, it has been suggested that malaria experts from India should be deputed to Italy to report on the subject. As the Hon. East India Company placed on record in 1855 the results of their deputing Captain BAIRD SMITH, R.E. to Italy, on the same errand, and thus secured a marvellous amount of information as to irrigation in Italy, and its connection with malaria, there seems little reason for going again to that country for facts which have been placed at disposal, but have been little utilised in India up to date.

Now whilst pointing to the difference between delta land in the east of Bengal as a recent formation, and that of Western and Central Bengal as land advanced to the condition of dead rivers, Dr. Bentley refuses to see any physical difference except in absence of fresh deposit of silt in the latter. He ignores entirely the contrast of phases of change in surface and subsoil configuration influencing grades of relief of surface and subsoil waters which the Drainage Committee has put on record, and which we have utilized in the Note just referred to. Dr. Bentley assumes that the sole factor concerned is the silt.

Dr. Bentley produces no statistics to prove impoverishment of soil in the older part of the delta, but, admitting impoverishment, and also putting aside the number of days lost to labour by illness and death

* Proceedings of the 3rd All-India Sanitary Conference held at Lucknow, January 19th to 27th, 1914. Vol. 1, Discussions and Resolutions.—*Supplement to the Indian Journal of Medical Research.* 1914. Calcutta: Thacker, Spink & Co.

ceremonies caused by malaria, and apathy in labour, may not the contrast be more readily sought in the failure of the ryot on old established land—except unfortunately in the neighbourhood of drinking-water tanks—to return to it that which he and his cattle have taken from it. Thus Fry states:—"The entire population defecate in the open, and instead of going to cultivated fields they as often as not choose the banks of their drinking tanks. Cattle refuse is seldom removed to manure their fields, which is both wasteful and insanitary." That newly-formed delta land which has not been exhausted by bad agriculture may give better production than the older areas under these circumstances may be true enough, but that, as a corollary, the presence of dead rivers and other causes of insufficient drainage in old formations are negligible factors in the production of malaria and, therefore, of the impoverishment of a sickly population, cannot be reasonably pleaded. Further, success of this silt panacea scheme, either in agriculture or as an anti-malarial measure, would demand that flood protection embankments be abolished and silt laden water be allowed to flow indefinitely in delta land already formed as well as under formation.

The silt that Dr. Bentley would have us picture is an unvarying factor in quality and always suitable for agriculture. But a study of CLEMESHA'S valuable work on the monsoon conditions on the Hooghly * shows that its quality and quantity are governed by many and variable factors affecting the rivers themselves and distance from the source of silt. In appealing to Italy, for instances of enrichment of the soil by its use for annual deposits on already formed agricultural land, the facts in support will be found scarce. Thus, the water from the Alps *en route* through Lombardy is freed absolutely of its silt by the chain of lakes of enormous depth which are found at the foot of the mountains, and seem none the worse for performing the function of silting reservoirs during many centuries. On the other hand, in Piedmont, in the absence of this system of natural deposit, according to Baird Smith, the fields at times receive a "fine grey sand deposit," which is a source both of worry to engineers regulating the canals and of loss to the agriculturists.

Far from dependence being placed on silt in Italy, it will be seen from the following quotation that, as elsewhere, the success of agriculture depends largely upon the discreet enrichment of the soil by manure.—

"The only great marsh in the Milanese proper is in the vicinity of Crema, between the Adda and the Serio. Throughout the Province of Mantua the soil is heavy and compact, necessitating the use of drainage as extensively as that of irrigation. In the Veronese it is very strong and light. In a word, the irrigated region is a great alluvial plain exhibiting the usual varieties of surface soil found in such formation, and enriched by an abundance of manure derived from the vast quantities of cattle which form the principal element of its prosperity. I have formerly mentioned, in illustration of this latter point, that within the triangle between Milan, Lodi and Pavia, it is calculated that there exists not less than 100,000 head of cattle, 25,000 horses, and 100,000 head of

*Proceedings 2nd All-India Sanitary Conference, Madras, November, 1912. Vol. 2. Hygiene, (1913 Simla: Govt. Central Branch Press).

smaller stock, as pigs, etc. **The whole of the manure supplied by which is applied to the enrichment of the soil.*"

That silting may be employed for reclamation of land, and thus render mere marshes valuable for subsequent agriculture, and that in the processes incident to land thus cultivated antimalarial measures will result automatically, is a well-known fact and has excellent illustration in Italy and Great Britain. Thus Baird-Smith reports of the Val di Chianna :—

"For a length of nearly 60 miles (the valley) had been reduced to the most frightful state of unhealthiness and depopulation by malarious influence" . . . . The whole of the works had been finished for some time and with the most remarkable results, the entire valley having been restored to culture occupied by an industrious and more healthy population, with the low, marshy localities all filled up and the waters now under perfect control."

But such instances are not to be confused with using silt-laden water by haphazard annual instalments over large areas of country, as a panacea for both soil impoverishment and malaria prevalence. Instances may be quoted to show that flooding and deposit of silt have resulted in improved agriculture and, temporarily, in less malaria. This is conceivable as a result of flushing of pools and silting of shallow pits; but nothing short of complete and careful regulation of the deposit as received in individual fields and persevering drainage of the country treated, including a full system for removal of water from the country after leaving its deposit, would secure fully favourable results, and this solely in deltas still under formation. Up to date of Baird-Smith's report, silting of the unhealthy marsh land of Groseto had proceeded for over twenty-three years at a cost of £60,000, and he estimated that a further expenditure of £150,000 would be necessary. In England, silting has been in use since 1846 for reclamation at the mouth of the Ouse, but only 2,500 acres have so far been recovered. Whilst silting, therefore, must be of great value under certain conditions, it is not a panacea; nor is the process instantaneous or automatic, and therefore free of financial effort. Dr. Bentley's paper should, however, do good in drawing public attention in Bengal to the long established truism of the close connection between *well-conducted* agriculture and anti-malaria measures.

Mosquito Nets.

In the Section of the Report of the Sanitary Commissioner with the Government of India for 1912, which is communicated by the Director, Medical Services, it is stated :—

"Until the use of mosquito nets by troops is general, it is unlikely that we shall obtain any great reduction in malaria prevalence. The Government of India have definitely decided to incur no expense in providing nets for soldiers other than a few selected places, the provision, therefore, of these protectors for the men, depends entirely upon regimental initiative. We are able to record a slow but steady increase of the use of nets by soldiers in barracks. Many are provided regimentally and a few are private purchases by the men themselves. There has been no abatement of active antimalarial measures in all garrisons by means of mosquito brigades. Concurrent with these activities, the administration of quinine has been steadily pressed and the combined influence of both these measures is slowly bearing fruit."

*Italics not in the original.

"Stoppages" are not popular with British troops but, putting aside this and the financial decision of the Government of India, the utility of mosquito nets as an anti-malaria measure has made more progress with Indian sepoys in Burma. Here in 1909, amongst 15,721 Military Police, 12,303 men had voluntarily provided themselves with mosquito nets, at their own expense.

Anti-Malaria Work in Singapore.

The Straits Settlements, of which Singapore is the chief town, comprise 1,599 square miles, having a population of 728,635. Of this number, 7,500 are Europeans, the bulk of orientals forming the remainder being Chinese and Malays. 39,969 labourers are employed on estates. The spleen rate for children in Singapore is 27·2 per cent., Penang 11 per cent., Malacca 70·3 per cent. In the interest of efficiency both of the labouring and town population, the necessity for anti-malarial measures is therefore evident. These are being conducted with activity and excellent care as to details, whilst the economy in their execution is very striking. The reporting officer suggests after careful dissection of available evidence that quite 45 per cent. of total cases of malaria are imported, but holds that the question as to the precise extent of endemic malaria in Singapore must remain an open question, in view of the very large proportion of the floating population. He states:—"As a result of the erroneous, sometimes conflicting, statements with which one has to deal, even the mind and the energies of such an eminent biometrician as Karl Pearson would be overtaxed to elaborate a formula which would give the ratio between endemic and imported malarial cases." But at least the local authorities seem resolved, by using the radical measure of drainage, to leave no removable cause of endemic malaria.

The locality has been inspected by Dr. Malcolm Watson, and hence the method of eradicating larvae spots from ravines has a family likeness to those successfully inaugurated by him in the Federated Malay States. Jungle has been cleared, marshes drained and ravines have been regulated and canalized, and subsoil drained. Each such work must necessarily have its own problem to solve, in which modifications of general principles must be employed. Here is one as stated in the Report, page 26:—

"Why the railway cuttings and such situations as MacKenzie Road, Mount Wallich, etc., have been selected, is due to the fact that, in excavating the soil, certain springs have been tapped which afford a continuous supply of clear water even in dry weather. The problem remains, how can one abolish such a flow? By piping, broken stone, or coral drains, covered by a layer of impervious soil to allow storm water to run over and inhibit silting? Great difficulty seems to arise in the construction of such a drain as will take away a slight flow, and not silt up rapidly. Granted, however, that such a drain does silt up comparatively quickly, I maintain that it is better to construct such and reduce the number of malarial carriers in all these situations, even though the drain has to be dug up, cleaned and reconstructed at intervals of some months, or mayhap years, when it becomes inefficient."

What is apparently required is a subsoil intercepting drain of agricultural tiles at right angles to the subsoil flow, and the chances are that if silting is, from the nature of the subsoil, specially dreaded, the system of open joints protected by loose gravel will give the best

results. Subsoil tile drains carefully laid afford good co-operation in duty, and granted a unit is put out of action there are always comrades within reach to take it up, so that this problem, we have no doubt, will be solved by local experience of results increasing faith in good work. Another difficulty alluded to is the scouring effect of flood water in ravines in exposing subsoil pipes. This certainly cannot be met by any uniform measures, and we think the methods adopted by Mr. Evans, the Engineer to the Federated Malay States Malaria Advisory Board at Kuala Lumpur, are peculiarly advantageous.

Larvae-eating Fish.

The Anti-Malarial Committee, Singapore (R. J. Farrer, Hon. Secretary) in their report for 1913 state that in a "shallow running ditch overgrown with weeds and other vegetation, larvae of *N. rossi* and *M. sinensis* are breeding out in enormous numbers, in spite of the fact that three types of larvae-eating fish are present in abundance :—*Haplochilus panchax* (vernacular—Ikan mata lalat), *Hemirhamphus fluviatilia* (Ikan julong julong), *Ophiocephalus striatus* (Ikan aruan)."

The subject of selection of suitable larvae-eating fish in India is being studied in the Bombay Bacteriological Laboratory. The matter certainly requires elucidation, as although there are plenty of voracious mosquito larvae eaters, it is necessary to distinguish those which in adolescence become strict vegetarians ; and, again, the fish who do not scruple to eat their larvae-eating brethren must be excluded. The verdict founded upon special observation may well be awaited, but if the *Chela argentea* (Chel-hul, Roochal, or "Havildars and twelve") acts up to its reputation, it should prove both a good larva and adult mosquito enemy, whilst being a fish of beauty and decidedly edible.

Mr. Wilson, Piscicultural Expert, Madras, has afforded the following opinion to the Sanitary Commissioner of that Presidency (G. O. No. 2409M, dated 16th Dec. 1912):—"It is advisable to stock different classes of water with different classes of fish, viz.—For tanks, swamps, and village ponds—*Chela* ; for wells, channels and stagnant pools—*Haplochilus* ; for backwaters, salt and brackish swamps and pools near the coast (these fish can also be used in fresh-water ponds)—*Therapon jarbua*."

As was stated in No. 7, Vol. 3 of this *Bulletin*, much good work was done in this direction by the late Mr. H. Thomas, I.C.S., as described in his "Rod in India." He studied pisciculture from an economic point of view, and protested energetically against the wholesale destruction of fish fry which occurs at the hands of villagers in irrigation channels as a waste of food sources. With him each village tank would have been converted into a place of food production, and hence he advised legislation for the protection of fry. The whole of the methods by which he would support his recommendations are simple in the extreme, and depended largely upon automatic means of allowing very small fry to escape to the river whence they were derived.

He calculated "from a very low average of the number of fry contained in 50 acres, this area must contain in all probability considerably more, and certainly not less, than 283,500,000 of diminutive fry," which if not destroyed "would represent at least at fair growth 253,125 tons of good food."

In judging the causes of freedom of malaria of certain areas under irrigation, obviously the question of the action of large armies of fish must not be forgotten, and the extent in certain areas to which their premature death is compassed by agriculturists. Time honoured rights of cultivators to destroy fish would doubtless require gentle handling, but economic pisciculture and malaria prevention would in this be hand in hand, and in parts of India the aid of the co-operation movement might be secured. The problem demands that before an agriculturist receives a flow of water on his land he shall so arrange that after use its surplus shall be conducted to correctly graded drainage channels; for whilst to allow water from irrigated fields to collect in pools is to harbour mosquito larvae, their drying up means death to the stranded fish fry.

Darling's *Larvicide.*

In the *American Journal of Public Health* of February, 1912, Dr. Darling, of the Chief Board of Health Laboratories, Ançon, published results obtained with the larvicide he had devised. Crude carbolic acid of a specific gravity not above 0·97, and containing 15 per cent. of tar acids, is heated in an iron tank by means of a steam coil under 50 lbs. pressure. Into 150 gals. of this, 200 lb. of crushed and sifted common rosin are introduced by stirring and, subsequently, 30 lb. caustic soda dissolved in 6 gals. of water. These amounts will yield about 3½ barrels of larvicide. He claims that as a bactericide this has an R.W. co-efficient of from 2 to 5, when tested with *B. typhosus*. When using it as a larvicide, he employs one part to five of water and distributes it by spray. This affords a milky opalescence representing approximately a dilution of 1 in 5,000.

On the Panama Canal at the period of Dr. Darling's Report on this subject, 250 barrels of the larvicide were being used per month. Darling states that in a dilution of 1 to 5,000 anopheline larvae die in five minutes, culex larvae in three minutes, and that it is destructive not only of larvae but also of algae and protozoa. It is evident, therefore, that the preparation has a wide sphere of utility.

Darling's experiments, however, disclose the fact that, whilst larvae readily died, pupae exhibited considerable resistance. But he overcomes this possible objection by showing that the typical anopheline of the locality (the *A. albimanus*) has an egg stage of two days, larval of nine and pupal two; so that the ordinary ruling as to application of a larvicide every seventh day will effectually prevent breeding.

Darling recognized that in contact with algae and protozoa exhaustion of the killing power of his larvicide might result, and he quotes Chick and Martin's experiments with emulsions of tar acids showing that the first action is that of absorption, and not a chemical combination. He, however, was able to demonstrate that the efficiency of the larvicide in contact with algae lasts "for at least seven days and certainly longer," and that when it is in contact with algae for a period of 1 to 7 days, 70 per cent. of the larvae are destroyed within 48 hours.

The question having arisen as to whether in Sierra Leone this larvicide would be equally effective as well as cheaper than kerosene oil, the officer in charge of the laboratory (Dr. Young) made a series of

experiments on the subject. He confirmed Darling's finding that pupae show resistance, and verified the destructive power upon larvae. No experiments were made as to influence upon algae, which necessarily would be a point of importance in differentiating the merits of larvicides. The officer condemned Darling's larvicide, firstly, on the admitted fact as to pupae, and secondly, on the ground that although the larvicide would cost but sevenpence against tenpence per gallon for kerosene, the measurement of the former, in practice, would be by volume of water treated, against the superficial measurement of the spread of kerosene. He makes no deduction as to rate of evaporation in the cost of kerosene. In coming to this conclusion, however, it seems to us he has ignored Darling's definition of the constituents of his larvicide, which runs as follows:—The specific gravity should be "not greater than 0·97 and contain not less than 15 per cent. tar acids. Each consignment of crude carbolic acid is assayed at the laboratory to determine its specific gravity and percentage of tar acids, for it is necessary to keep the product of a specific gravity approximately that of water, *so that it will diffuse rapidly and neither sink to the bottom nor remain on the surface.*" (Italics not in the original.) Of course, although this is not stated, it is possible the larvicide was carefully tested by the officer conducting the experiments, and fulfilled requirements in these respects; but, granting this was so, it was obvious that whilst his tests were of utility as a contrast with kerosene, the actual experiments with the larvicide were but a verification of Darling's own results with solutions up to a single strength. The test necessary is to ascertain whether these dilutions are obtainable in nature as a result of spraying pools; and it seems to the writer that the only way this could be gauged would be by securing specimens of strata of water at different depths and at different times in pools which had been sprayed, and with solutions so obtained ascertaining the effects upon larvae. In the meantime, Darling's experiments must be regarded as of a convincing nature.

Are Larvicides inimical to Other Forms of Animal Life?

It would appear that the practice of treating ponds and other natural collections of water with petroleum and disinfectants for the purpose of destroying mosquito-larvae has aroused considerable opposition in Germany from naturalists and other lovers of nature. It has been asserted that such procedures necessarily destroy fishes and other feeders upon mosquito-larvae so as to do more harm than good in the long run, and it is said that birds and other wild animals are thereby deprived of their natural drinking-water, or are actually poisoned. The microscopic fauna and flora of such bodies of water are also said to be necessarily destroyed.

In order to test the truth of these allegations, Rost* and Schuberg†

*Rost (E.). Zur Kenntnis der Wirkungen kresolhaltiger Desinfektionsmittel (Saprol, Lysol, Kreolin) und des Petroleums bei Tieren. [A Contribution to our Knowledge of the Action of Cresol-containing disinfectants and Petroleum upon Animals.]—*Arbeit. a. d. Kaiserl. Gesundheitsamte.* 1914. Mar. Vol. 47. No. 2, pp. 240–251.

†Schuberg (A.). Naturschutz und Mückenbekämpfung. Versuche über die Einwirkung zur Vernichtung von Mückenlarven dienender Flüssigkeiten auf Wassertiere und Vögel. [Animal Protection and Destruction of Mosquitoes].—*Ibid.* pp. 252–290.

[Summarised by Dr. J. B. Nias].

jointly undertook to investigate the question. Rost tested the action of petroleum and cresol-containing disinfectants upon laboratory animals, such as dogs and guinea-pigs, while Schuberg tried the same substance upon fishes, tadpoles and microscopic crustacea kept in aquaria. The effect of adding the same substances to the drinking-water of cage-birds was also investigated.

Briefly the authors' conclusions are as follows :—

1. The toxic action of Saprol, Lysol and similar cresol-containing disinfectants depends upon the amount of cresol which they contain.

2. There appears to be no such thing as chronic cresol-poisoning. A succession of non-lethal doses administered to an animal produces no ulterior effect.

3. Commercial petroleum is but slightly toxic, even in large doses, to laboratory animals. It produces only slight narcotism.

4. Petroleum, when extended upon the surface of water, gives off no products which can contaminate the subjacent liquid by diffusion. It suffocates mosquito larvae mechanically, by preventing them from taking in air at the surface. It has no effect upon fishes or other animals which breathe by means of gills, provided that the water contains enough vegetation to furnish the requisite oxygen. The same may be said of microscopic pond-life.

5. In the proportions commonly used for the destruction of mosquito-larvae, the cresol-containing disinfectants are not noxious to the higher forms of animal life, such as fishes and other destroyers of mosquito larvae ; and as regards the microscopic forms of pond-life, their reproduction is so rapid that the application of such disinfectants during a limited period can do but little permanent harm.

6. Birds do not refuse to drink from water spread with a thin film of petroleum, or containing cresol-disinfectants in the ordinary proportions used.

7. The fears of naturalists are therefore not considered justified.

Yellow Fever.

Stegomyia Traps.

A trap for stegomyia is suggested by Captain Horne, I.M.S., Special Malaria Officer, Madras, in the following terms* :—

" In view of the conditions that maintain in the large Indian towns, it cannot be expected that all breeding places of *Stegomyia fasciata* will be wiped out by anti-mosquito measures. A few will remain and continue to breed out adult stegomyiae. These adults finding their ordinary breeding places very scanty, will have a tendency to seek out others that are difficult of discovery and access. It is to prevent this that the traps are used.

Ordinary earthenware gurrahs are most suitable for the purpose : they are kept half filled with water and emptied once a week. All eggs laid in these and larvae that have developed from them will thus be got rid of every week, and the output of survivors greatly reduced.

They should be used in sets of three, only in authorized places (police stations, post offices or factory yards, etc.) in areas where the stegomyia is most in evidence in spite of anti-mosquito measures. Thorough control is of course absolutely essential ; otherwise they will do more harm than good."

The following is a trap suggested by Major S. P. James, I.M.S., in his recent paper " Mosquito work in Ceylon," read before the Society

* Madras G.O. No. 127 Pub. 28 Jan. 1904.

of Tropical Medicine and Hygiene. The idea of using trapping extensively in aid of mosquito reduction he ascribes to Mr. Howlett, Imperial Entomologist, Government of India :—

"One of the traps that we have found most successful consists of a rectangular wood framework, 5 feet long, 3 feet deep and 3 feet broad, closed with mosquito netting, one end of the trap being a door on hinges. We place these traps on the ground in the shady corner of a garden, and cover them with sacking and a thick tarpaulin, so that the interior is dark and cool. Two or three pots of plants are put inside each trap and several near the door, which is left partly open. Our second picture shews one of the traps set in the manner described. We set the traps overnight, and the next morning, about nine o'clock, we send beaters through the vegetation in the neighbourhood of the traps, and we burn straw torches in all the surrounding buildings so as to drive the mosquitos into the open air. The result is that most of them quickly find their way into the traps, which appear to them to be very attractive and cool resting-places. After completing the disturbance of vegetation and the smoking of surrounding buildings we close the door of the trap, and collect and count the imprisoned mosquitos."*

Plague.

Plague in Mauritius.

During 1912, there were 656 cases of plague with a mortality of 82·5 per cent. The epidemic was a continuation of that of 1911, there being only 14 days freedom of cases throughout the year. Of the total 44 were pneumonic, 7 septicaemic, and 27 abubonic cases. In his Report on the latter the Director of the Health and Medical Department (Dr. R. Denman) states : "The fatality which attended them is responsible for the very high death-rate for plague this year." 414 persons on one of the infected estates were inoculated with Haffkine's vaccine. The total number of cases was 13 with 10 deaths. Of the latter three had been inoculated 15 days previously.

Plague in Mombasa.

Plague is surely but steadily putting at defiance various theories of "immunity" of localities. Ceylon is a recent case in point. Mombasa also lost its fame in this respect, on the 28th August, 1912. A group of four deaths from pneumonic plague first brought the disease to notice. Finally, it became known that 13 members of one household, who had either lived in the infected house and tended the sick, or visited them, had succumbed to plague. The rats in the house when pneumonic cases were first found were infected. No mention of the occurrence of bubonic cases is made in the Report, and the relation of rat infection to the outbreak cannot be traced. The local authorities had difficulty in dealing with concealment of cases by Indans.

Plague in Ceylon.

It will be remembered that, at its origin, plague in this locality was exclusively septicaemic, and that, gradually, bubonic cases appeared. Accounts received up to 15th June—in so far as the types have been

* Horne's method aims at a massacre of the innocents, James's at outwitting the wily and expectant mother. A combination of the methods should be useful in practice.

differentiated—show that the septicaemic form still predominates, although the bubonic is steadily asserting itself. Thus, whilst from the 25th January to the 26th February, in 46 cases there were only nine cases which were bubonic, from the 25th March to the 15th June, in differentiated cases, there were 36 septicaemic to 29 bubonic. In new centres of human infection, Symond's Road and Forbes Road, in spite of diligent and special search—in the latter case in front of plague advance—no infected rats were found till the 14th June and 22nd June, respectively. In the former locality the first person found infected was a "latrine woman" on the 20th April: by the 15th May five other cases occurred—the first being on the 5th May—and between this date and the 23rd May there were two other cases.

The epizootic is spreading slowly. In infected localities, infection of rats examined have varied from 1·9 to 4·6 per cent. The *M. norvegicus* and *M. rattus* appear fairly well to divide the onus of infection—there being about 33 of the former to 30 of the latter. One rat is reported as an instance of septicaemic plague. 17 persons died in Hospital as plague subjects, but bacteriological examination failed to discover the *B. pestis*.

In a village four miles from Colombo, between the 22nd of February and the 5th of March, six persons died of plague in one house. The source of infection was traced to an infected locality in Colombo. In this case the type of plague is not stated, and no suggestion is made of rat infection.

Rats.

Before it is possible to excogitate a successful method of rat-proofing a building, it is essential that the extent to which they can pass obstructions be ascertained. Asst. Surgeon Creel,* United States Health Service, has made serviceable experiments on this subject.

As to their swimming powers, he found that a *Mus norvegicus* released 450 feet from the shore reached land in six minutes; another released 1,300 feet from land swam a total of 1,500 feet and reached shore in 55 minutes.

When confined within a stockade made of galvanized iron, sunk 3 feet into the ground, they burrowed 2½ feet into the soil. Usually, the depth of a burrow does not exceed 1½ feet, but "burrows have been noticed passing beneath walls of two feet depth." Confined in a stockade they climbed a tree; also a one-inch pipe. They are capable of jumping 17 inches upwards or outwards.

The *Mus rattus* and *alexandrinus* released 1,500 feet from shore failed to reach it, having apparently no sense of direction, but kept afloat for 45 and 55 minutes, respectively. They do not burrow, but hide themselves behind any convenient article or projection. A specimen, presumably a hybrid, made a hollow in the ground in which it hid, but did not burrow. According to the Dutch in Java, the hollow bamboos in buildings are favourite places for nesting. Both the *Mus rattus* and *alexandrinus* climb well, and are capable of jumping

* Creel (R. H.). The Rat. Its Habits and their Relation to Anti-plague Measures.—*U.S. Public Health Reports*, 1913, Vol. 28, Pt. 1. pp. 383–386.

upwards two feet; and in one instance a *Mus rattus* confined within a perfectly smooth galvanized garbage bin of 24 inches depth "by a series of jumps spiralled its way to the top of can and escaped." He found that the *Mus norvegicus* will pass through the hardest ground: they can pierce the body of sun-dried brick, but usually the hole is made through bad joints of lime mortar. He discredits the Indian Plague Commission's statement that rats pass through concrete, but it is probable that the American "concrete" he refers to is made with cement instead of, as is more common in India, lime: indeed, we find from consultation of a good American Dictionary the usual acceptance of the word "concrete" is the form made with cement.

On referring to pp. 771–772 of *Journal of Hygiene*, Vol. 7, No. 3, it is found that the Commission states that both the floors and walls of houses are riddled with the holes and burrows of *Mus decumanus* and *Mus rattus*. The walls are described as of burnt brick and mortar, whilst both the immediate outer and inner surfaces of the walls are plastered with lime.

The further evidence of the Indian Plague Commission on the subject of rat habits also shows that these may be modified by environment. At pp. 746–748 of the same volume they state that the *Mus rattus*, though typically a climbing rat, is able to burrow into a beaten-earth floor. *Mus decumanus* "is a burrowing animal with remarkable powers for gnawing through hard material, e.g. brick and concrete, but it is also a good climber." The *Mus decumanus* at Bombay is to a certain extent a house rat. "Extensive burrows" by this rat were found in the chunam [lime] floor of a living room and also in a second floor of an office.

Before proceeding to make rules as to rat-proofing of buildings, a conference of officers of the Public Works Department in Burma made experiments in 1910. As a result, they stated as follows:—"Rats can jump two and half feet; can climb any vertical surface which is not smooth, dense, and hard; can surmount any horizontal projection of less than six inches, if the material be such as they can climb on a vertical surface; and can walk along a thin suspended wire."

Asst. Surgeon Creel states that, under natural conditions, the *Mus rattus* and *alexandrinus* will climb coconut trees of any height, drain pipes and wires, and get from one building to another by passing over wires.

The following deduction by a former Sanitary Commissioner with the Government of Madras (W. G. King) (Report embodied in G.O. No. 1989, dated 27th January 1904) may also be of some value as to rat habits in reference to epidemiology:

"Even in the midst of an epidemic, although undoubtedly they are a serious source of spread of infection amongst the free population, the area over which infected rats operate in a town is very limited. Possibly rats, as in the case of monkeys, form separate tribes, which have their own limited territory, recognized by inter-tribal agreement, so that there is little intermingling of rats of various areas in the town. Even when we come to the question of migration, the rats only of a limited portion of the town are invariably involved."

Prof. Boycott* has placed on record the fact that in two localities

Guy's Hospital Gazette, 1911. Vol. 25, pp. 73, 318.

distant only 100 yards from each other, the fleas infecting rats were markedly different. Thus, as summarized at p. 9, *Journal of Hygiene*, Vol. 11, Supplement I, Sixth Report on Plague Investigations in India, "in locality A, 94 per cent. were *C. fasciatus*, while in locality B, 97 per cent. were *X. cheopis*. In all 24 rats yielded 457 fleas, an average of 19 fleas per rat." Although aware this evidence is not conclusive, he considers it suggestive of tribal habits, in that intimate inter-communication was improbable.

The moral is, prompt action against rats on the first sign of an epizootic; especially that adopted by the Japanese of surrounding suspected dwellings by corrugated iron sunk in the ground and sufficiently high above it to prevent escape either by burrowing or climbing.

Rat Destruction.

According to Major C. E. Southon, I.M.S.,* Chief Plague Medical Officer, Punjab, a simple method of rat destruction has been lately used largely in the Punjab, which is carried out by means of the so-called "smoke stove." He states:—

"Smoke is generated in a cylinder, using straw or any other cheap substance which will produce acrid smoke, and this is forced down rat holes by means of bellows. Exit holes are closed and rats are quickly suffocated. Sulphur is also sometimes added to the straw, and the fumes produced cause very rapid death, not only of the rat, but also of the fleas on it. From our present knowledge it would appear that this method is very suitable to towns, especially those which are well built, and where the rat population is to be found on the floor level and under it. It is not quite so efficacious in thatched or tiled villages where rats live on the roof level. At the same time it would appear from certain experiments that the smoking of a village on one occasion, that is one or two day's work, is equivalent in result to the trapping of that village for one month. A combination of the two methods would certainly prove of great value. The advantages of this method are that it is cheap, rapid, kills both the flea and the rat, and moreover the rat has no say in the matter, and most important of all it offends no religious prejudice. The disadvantages are that very careful and reliable supervision is needed, and it is not so adaptable to villages."

This is really an adaptation of a method much employed by Indians to get rid of bandicoots. They bore a hole in an earthen water vessel (chatty or gurra), partially fill it with easily combustible rubbish, drop in a piece of live charcoal, place the narrow mouth of the vessel over the entrance of a burrow, adapted by a little clay surrounding it, and by adjusting their lips to the hole, manage to produce a lively draught by blowing. They aid the resolve of the animals in a burrow to bolt or die by adding chillies to the burning mass, and thus produce fumes irritating alike to the eyes and respiratory passages. The writer first saw this method used for anti-plague purposes in 1907 by Major C. E. Williams, Sanitary Commissioner for Burma, who replaced the earthen chatty by a kerosene tin, to which he attached a flexible tube, and the expiratory efforts of human beings by a bellows.

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* Report on the Sanitary Administration of the Punjab, 1912; Punjab Government Press.

The Madras Plague Prevention System.

In their Order No. 218 P, dated 31st March, 1914, the Government of Madras have directed, subsequent to June 1st of this year, that certain changes in their method of combating plague shall be effected. The present system has been in use with but little modification since September 1896, when plague was first declared to exist in Bombay. Descriptions of the method in current sanitary literature, from time to time, have erroneously assigned its chief peculiarity as a segregation of contacts and patients coupled with surveillance of populations. In connection with the comparative immunity of the Presidency of Madras under this system compared with the rest of India, it has been sought to prove that this organization has had little or nothing to do with the results, and that still undiscovered natural features account for the difference in plague spread. In view of its present modification, therefore, it may be of interest to epidemiologists to sketch the chief peculiarities of what was the first complete organization against plague in the present pandemic, throughout both rural and urban areas, in a total of 143,000 square miles, containing a population of, at the present day, 41½ millions.

The first line of defence was the formation of a system by which it was possible to trace movements of persons from infected foreign territory, as well as from within the territory guarded if it became infected. It was required that all persons arriving or departing from an infected area should receive a passport declaring their destination. Of this form a duplicate was forwarded to an appointed authority at the proposed destination, this being the first point of arrival on a journey, whilst a triplicate was recorded locally. A series of rulings enabled authorities to serve passports upon persons attempting evasion, known or suspected to be recent arrivals from an infected locality. All authorities were kept informed of the position of these infected localities. A passport holder was free to move from place to place; but if he stayed in any locality over twelve hours, he was bound to report himself once daily for health surveillance. This was originally maintained during ten, and latterly, seven days. *The whole system was a protest against quarantine or segregation.* Segregation of particularly untrustworthy "contacts" could be enforced at local discretion, but contacts of ordinary character could *not* be segregated after the incidence of three indigenous cases, in the locality concerned, had suggested epidemic prevalence. After disinfection they were free, but were required to reside in approved residences in the neighbourhood of the infected area. They were then required to subject themselves to surveillance daily. Contacts and their property were however allowed to leave infected areas if and when they exchanged *local* surveillance "passes" for "passports," after disinfection of all clothing and property *immediately before* departure from the area concerned, and on production of a certificate from a member of the sanitary staff that this had been accomplished.

Subject to local discretion, compulsory segregation of patients was advised as to the first three indigenous cases and of all imported cases, but beyond this local authorities treated patients under ordinary principles as to suitability of accommodation, especially in regard to

pneumonic cases. Segregation, therefore, was but a very limited factor, except in respect to imported plague patients.

In all threatened areas a campaign against rats was ordered, and technically trained sanitary staffs were retained in so-called "observation circles," in both rural and urban areas, in proportion to area and population. These staffs were uniformly placed in advance of plague progress—a matter rendered largely possible by information obtained from the amount and direction of exodus from infected areas, as shown by passports. Not only were steps taken to observe the person holding the passport, but "notification of disease," which is now solely to be relied upon, was also legally enforced in the event of an occurrence in the house visited by a passport holder, thus, "any case of illness or death in the house in which such passport holder is, or has been residing, shall forthwith be reported to the nearest plague officer,"* etc., etc. Reports of all imported cases in uninfected areas reached local civil and sanitary authorities, the Government and their Sanitary Commissioner, by telegram. Full histories of the first three indigenous cases were supplied within 24 hours to the Government, through the Sanitary Commissioner.

The rat as a "conveyor of disease" and its killing as a "precautionary measure" in advance of plague was duly officially recognized in September, 1896 and November, 1896, respectively.† The importance of maintaining observation circles in recently infected areas during the following hot season, which is now being advised as a prominent precaution in plague measures in India generally, was also officially recognized (Madras G.O. No. 7950, dated 16th May, 1902), and was re-affirmed by the Government in paragraph 7, G.O. No. 272P, dated 6th March, 1903. In an organization where staffs were ever pushed in front of plague advance and information in detail was promptly forthcoming, it was concluded *ordinarily* (as a result not of predilection but of careful enquiry) that a rat epizootic in newly-infected areas represented a failure of sanitary precaution as to the more frequent traveller of distances, namely, man, and rat plague was therefore most carefully watched for and was met in the spirit of temporary defeat accordingly, by using prompt evacuation and inoculation. Grain as a recognized rat carrier was dealt with by destruction of small quantities as found in households, and by strict disinfection by sunlight, and lapse of time, of large stores within infected areas. Although SIMOND'S flea theory was acted upon by executive sanitary staffs subsequent to 1898, the system lacked the advantage of the important knowledge gained by the Indian Plague Investigation Committee as to scope of flea infection, but knowledge as obtained from time to time was readily adaptable to the whole system, without in any way disturbing the main features of the organization. Indeed, no greater alteration of Madras Plague Regulations than the use of a pulicide as well as a germicide in disinfection was requisite. So that, in throwing away a portion of the system, whose chief value was the linking of official and non-official measures so as to gain prompt and accurate intelligence against disease spread, the rest of the organization remains but little touched.

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*Madras Plague Regulations. Part I, Rule 7.

†On deductions from Reports as to the disease in Gharwal and Hongkong.

After careful consideration of the present position of affairs the Government of Madras has restricted attempts to watch movements of travellers by land from infected areas to travellers by rail, and will trust entirely to the system of observation circles in the case of travellers by road or river, and abolish rules under which arrivals are bound to place themselves personally under surveillance for a period of one week at their destination. These particular travellers will be required to receive a document which enforces notification. It remains to be seen whether the new system can equally secure prompt intelligence.

The important part on the new basis will be that "observation circles" instead of being (for financial reasons) thrown out solely over threatened areas, as hitherto, will be maintained permanently in all parts of the Presidency neighbouring foreign territory, where plague has become indigenous for a prolonged period, namely, in Mysore, Bombay and Hyderabad. This implies a further advance in the organization of a permanently executive sanitary staff for routine service in rural areas, as plague prevention will not alone receive attention.

A former Sanitary Commissioner (W. G. King), after holding that precipitate withdrawal of temporary plague staffs during hot weather was the real cause of so-called "recrudescence," stated (Madras G.O. No. 198P, dated 27th February, 1904) "the moral is (and I speak only for conditions in this Presidency) that given correctly trained staffs employed in numbers sufficiently large to keep the population under surveillance during the whole year and not solely during the cold season, plague could be confined to imported cases received from foreign territory." If the permanent staffs fulfil the requirement of being "sufficiently large," this theory will receive a test.

Under the old passport rules, the onus of reporting sickness rested with the householder, medical practitioners and local authorities, under various sections of the Plague Regulations, but under the new "notification system," this responsibility is thrown upon the traveller. The form is as follows :—"I of proceeding to do hereby bind myself to deliver this notification to the Local Authority of that place on my arrival, and to report to him any case of fever or plague or of unusual mortality among rats in the house occupied by me within a period of one month after my arrival." Having regard to the text of this notification, it does not seem that there is any desire to ascertain the condition of houses visited by apparently healthy travellers (and perhaps flea bearers) *en route* from place to place, which was possible under the old ruling we have quoted ; presumably, the authorities will be content hereafter to receive information from persons after their arrival at an *ultimate* destination, as it can hardly be intended that the person responsible is to be allowed to delay notifying events following his presence in a house to any period that may be convenient to him, provided it be within one month of his arrival.

Beriberi.

"*Cured*" *Rice.*

It is a popular fallacy that "cured rice" is that generally employed by Indians. On the contrary, its use is confined to very small sections of such few as employ rice (in comparison with users of the cheaper dry grains); ordinarily, these employ rice made free of husk by hand-pounding and winnowing. Again, with some, "Burma rice" implies that all Burmans eat mill-polished rice. This is not the case; although Burmans in urban areas may employ it, the typical Burman of rura areas and all jail prisoners use simple "husked" (decorticated) paddy. Again, the ordinary idea of cured rice is that there is involved a process of "parboiling" which may help to preserve it from deterioration. This may incidentally be so, but the Indian secures changes in the grain, before the boiling which gives it peculiar flavours, and it is to secure these that the processes are carried out. This is evident from the following extract from an official Report by the writer (1904) on inspecting the trade process:—"Paddy is soaked in cold water in large earthenware tubs, for a period of 48 hours for the inferior varieties of grain and 24 hours for the superior, until a certain grade of fermentation is obtained. It is then placed in chatties over a fire, until a temperature of 212° F. is obtained. This effectually checks fermentation* of the now bulky grain and, presumably, kills all non-sporing germs that may have been acquired during contact in the process of soakage with the undesirable quality of water to which I later on allude. The grain is then placed upon the platforms of brick to dry and cool. The process of paddy-boiling probably produces saccharine matters that are tasteful to the consumers and represent a stage in the process of change of starch that may, as claimed by all who use such rice, aid digestion. But, as pointed out in special reports written by me in 1882 and 1891, the use of a grain rendered artificially bulky means less nutriment for the consumer who buys by measurement."

The Phosphorus Pentoxide Contents of Rice Pericarp.

The following extract given by Dr. Heiser in his paper on beriberi in the *Medical Record*† should prove very useful as an approximate test of extent of pericarp destruction in rice:—"Any rice that stains deeply with Loeffler's methylene blue or Churchill's tincture of iodine, contains less than 0·4 per cent. of P_2O_5 and a rice that stains only slightly contains more than 0·4 per cent. of P_2O_5."

Polished Rice.

If the influence of moulds on rice is to be studied, a knowledge of its chemical composition will probably be required besides that of the pericarp which hitherto has had, on good ground, the first attention. As there are about 160 varieties of rice and endless qualities, it is to be hoped that information as to the pericarp will suffice; but, Mr. F. J. Warth, M.Sc., Agricultural Chemist to the Government of Burma, has made experiments which at least must remove certain of the inherent

*The term "germination" would probably have been more applicable to the grain, and "fermentation" to the fluid in which it was soaked.

†Heiser (Victor G.). Beriberi. An additional experience at Culion. How can a knowledge as to its prevention best be applied from the standpoint of State medicine?—*Med. Record*, 1914. Jan. 31. Vol. 85. No. 5. pp. 186–188.

difficulties to such a study. Although primarily in the interest of agriculture and commerce, they have a value to the sanitarian in the matter of beriberi. In *Bulletin* No. 38 of 1914 of the Agricultural Research Institute, Pusa, he opens the subject by pointing to the fact that it is customary to use alkalies to disintegrate grain in the course of removing proteids in the manufacture of starch, and that SYMONS* had suggested "a method for distinguishing starches in this way, as he found different concentrations of alkali are required for the same effects on starches derived from different vegetable products." Warth followed this idea up by attempting to ascertain "more than we do at present about those physical properties of starch which determine its resistance towards alkali." His experiments led him to believe that, by using various dilutions of alkalis, noting the extent of disintegration and liquefaction, as checked by time and temperature, it is possible to "establish a co-relation between the action of alkali and the quality of starch in the grain, so that to the agriculturist and grain dealer "the alkali test may form a useful method of roughly judging rices."

In preliminary experiments he dealt with polished and husked rice. He found that sodium carbonate had no effect upon either. But in solution of potassium hydrate of a strength of 5 to 10 per cent. unpolished grains were not affected, whilst polished grains "were rapidly disintegrated and dissolved." In solutions of 1 to 2 per cent., in incompletely polished grain, the patches of unremoved pericarp were "at once made evident." Again, the extent to which polishing removes the pericarp may be judged by the following table giving comparative weight before and after treatment :—

POLISHING GIVEN TO EIGHT RICE VARIETIES.

Variety.	Weight of 50 seeds unpolished.	Weight of 50 seeds after polishing.	Weight lost in polishing.
No. 1	1·2550	1·1014	·1536
„ 2	1·1961	1·0676	·1285
„ 3	1·2874	1·1393	·1481
„ 4	1·1364	1·0248	·1116
„ 5	1·1676	1·0492	·1184
„ 6	1·2172	1·0512	·1660
„ 7	1·0676	·9700	·0976
„ 8	1·5405	1·3706	·1699

He found that whilst a difference in two varieties of grain could be gauged with every concentration of alkali, "there is evidently little or no difference to be found between the polished and twice polished samples."

Although a sanitary officer is not likely to select a camp supply of polished grain in the present day, circumstances might require him

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to distinguish between samples of rice of the polished variety. The following table illustrates Warth's results in 24 hours :—

ACTION OF KOH (POTASSIUM HYDRATE) ON EIGHT PADDY VARIETIES.

	Variety	1·0 p.c. KOH	1·25 p.c. KOH	1·50 p.c. KOH	1·75 p.c. KOH	2·00 p.c. KOH
Less resistant varieties.	No. 1 ..	Slight effect	Diffusing	Seeds destroyed	Much gelatinisation	Completely gelatinised.
	No. 3 ..	Disintegrating ..	Diffused	Much gelatinisation	Completely gelatinised	
	No. 7 ..	Slight effect	Diffusing	Seeds destroyed	Much gelatinisation	
	No. 8 ..	Some effect	Diffusing	Seeds destroyed	Some gelatinisation	

Mouldy Rice and Beriberi.

There is ample evidence at disposal showing that FRASER and STANTON'S contention as to absence of the pericarp in polished rice representing a serious factor in a form of " beriberi," is correct ; an open question, as they allow, is whether the term as used in various countries is not applicable to other as yet imperfectly differentiated diseases. There are still the exponents of hypothetical insect-borne micro-organisms to be dealt with, whilst the group of diet deficiency diseases is expanding. Amongst other matters, it is of interest to ascertain whether rice may not be deprived of its phosphate-bearing pericarp by other processes than milling; for example, owing to injury bymoulds and, in this case, whether injurious chemical changes may not be produced in grain notwithstanding subsequent cooking. In this connection, it is worth remembering as to polished rice that it is dealt with in enormous quantities *in bulk* and that before it is transported from rural areas to collecting agents, and by them is forwarded to central spots where rice mills work, there may be many vicissitudes of exposure to alternate wet and heat, especially whilst awaiting transport in bags by railways short of waggons. If the unhusked grain will stand polishing on arrival at the mills, it suffices for trade purposes.

Dr. CHEVALLIER,* in Appendix 3 attached to the Annual Medical Report of the East Africa Protectorate, 1912, deals with an outbreak of beriberi at Serenli amongst native troops and, whilst not forgetting Fraser and Stanton's work, endeavours to dissect facts as observed without bias. He reports 112 cases, with 44 deaths, between November 1911 and April 1912. In the first place, general defective nutrition of these men was possible, as they were supplied with a Government ration which was professedly but partial, as they were expected to supplement it locally. As it happened, local purchases could not be made, and transport difficulties conspired to keep them

*Report on Beriberi at Serenli, December 1911 to May 1912.—*East Africa Protectorate Ann. Med. Report for year ending 31st December* 1912, pp. 68–77.

on short commons. No polished rice was used—white Halwa rice (commonly used by the civil population without any evil results) was alone available. Dr. Chevallier, however, is of opinion that the difference between general malnutrition and beriberi was brought about by the rice ration reaching the men in a damaged condition, consequent upon transport and local storage arrangements "when many of the bags became wet." He then states :—

"Surely, it is conceivable that rice may become so affected in course of time, especially when exposed to wet and heat, and after much transport in single bags of sacking, as to approach the condition of the polished variety to the extent of losing the same constituents contained in the layer under the pericarp."

The facts so far—in absence of evidence of the phosphorus contents of the rice—would fit in with Fraser and Stanton's ideas if previous malnutrition be regarded as the predisposing cause, and moulds be held to have affected the grain, as well as weevils mentioned by Chevallier. But he shows that an escort of 25 men left Serenli just before the outbreak, took with them the same rice and, apparently, were not better off as to daily rations, yet they were free of beriberi. Again, the women of the troops had only one attack of the disease up to February 15th, 1912,but, subsequent to an order to thoroughly clean out their huts, there were 19 cases amongst them with five deaths. Such facts point to local causation, and moulds imported with rice as an hypothesis.

Dr. Gilbert L. Brook, formerly Editor of the *Malay Medical Journal*, has recorded details that would favour the local disease theory to which the *Indian Medical Gazette*, in 1912, called special attention. According to him, in a jail and an asylum both using, during twenty-seven years, over-milled rice, there were shown no marked differences in health. During the first five years both were affected with beriberi, followed by a period of nearly fourteen years' freedom from the disease. This was terminated by a period of the presence of beriberi in the Asylum of nine years. This outbreak, in 1896, coincided with the presence of the disease in the free population of Singapore. Two years later it appeared in the jail, and this outbreak had a duration of eight years. To this we may add the statement (*Madras Quarterly Medical Journal*, of 1839, Vol. 1) that in 1829 there was beriberi amongst the sepoys in Singapore, but amongst the convicts "who had a similar diet, were worse clothed, more exposed and laboured harder during the day, not a single case of beriberi occurred."

These facts would point not only to a disease of locality as held by Manson, but to seasonal conditions modifying the causative agents.

On this subject, Dr. John R. Gimlette,* Residency Surgeon, Malay States, has also placed on record matters of much interest. He had under personal observation the hygienic conditions of imported and indigenous labour in the Kelantan State (Federated Malay States). Indigenous labourers were, up to 1904, free of beriberi. They used hand-pounded husked rice. Healthy Chinese coolies were imported in 1903. They were fed on milled rice. In 1904 in a strength of 250, eight cases of beriberi occurred. In 1905, there were in a strength

*Beriberi in Kelantan.—*Rept. of Advisory Committee for Trop. Diseases Research Fund for the year* 1913, pp. 223–227.

of 400, 105 cases with 17 deaths amongst the miners. On BRADDON'S hypothesis, in 1905, Gimlette conceived "the illness was caused by the consumption of the rice, because it had become mouldy in the bags owing to damp, unavoidable delay and difficulty in transport." The use of hand-pounded rice was advised but apparently not carried out, as storage was not feasible.

Early in 1906 the disease disappeared, though milled rice continued to be largely used. A point in the history which is not emphasized by Dr. Gimlette, which we suggest may, on the mould question, be of some importance—having regard to coolie methods of carrying about food articles to work spots—is that this freedom was synchronous with stoppage of underground labour by miners. Meanwhile, many but not all Chinese coolies had left the locality. In 1907, with new coolies on rubber estates, beriberi appeared.

"Thirty-nine Chinese coolies and two Javanese came into hospital from the estate, and out of these twelve Chinese and one Javanese died. Ten cases remained in the wards at the end of 1907, and nine of these were dead before the end of January, 1908. The situation was grave; seven coolies who were in hospital *for ulcers* were attacked with beriberi, and they all died. There were eleven deaths in the wards in January, 1908, and thirteen new cases were admitted from the estate. The bulk of the hospital diets consisted of Rangoon rice, which was well cooked in the ordinary way and not steamed. An enquiry was made into all the rice and food supplies; the diets were found lacking in variety, and mouldy Rangoon rice was found again, but it was not present to the extent that had occurred at the mines in 1905. *The hospital wards were well cleaned, painted, whitewashed* and thoroughly swabbed with perchloride of mercury, 1 in 500; this appeared to have a good effect. In February there were only five new cases, including one Javanese, with no deaths."*

Siam rice No. 2, a more highly polished rice, was then used, but no more cases occurred till December, when there were four cases with two deaths. This rice was continued up to September, 1909. In that year, 13 cases were distributed between January, February and March, and there were 15 in December. There were no cases in the other months. Dr. Gimlette's statement now leaves it to be understood that although the stored Siam rice was still in use, hand-pounded rice was employed by the majority—a few Tamils having "cured rice." Fourteen cases were traced to the camp of a badly fed batch of Chinese coolies under a contractor, but beyond these instances the whole State of Kelantan appeared free of beriberi; although it is understood the importation of polished rice for the general population continued, side by side, with the use of hand-pounded rice. He then quotes A. G. H. SMART as stating:—"In view of the prevalence of beriberi in previous years and the high death rates produced, it is a striking fact that, out of 2,256 admissions to hospital during 1911, no case of beriberi was noticed."

Dr. Gimlette considers that in Kelantan the disease seems to have been more prevalent after heavy rainfalls, when moulds are favoured. The chief monsoon is the North-East from October to March, and a minor South-West monsoon occurs from April to September. He states that, in 1905, when beriberi was prevalent in the mines during the South-West monsoon, "it was found the rice in use was very

*Italics not in the original.

mouldy." He then suggests, as does Dr. Chevallier, that in mouldy rice the phosphorous constituents of the pericarp are destroyed, and points out that the Malays only hand-pound a store for three days' consumption and thus are protected. Thereupon, he concludes :—

"It follows that hygiene, when applied to the imported food supplies of labourers segregated in numbers in lonely places, may be of greater benefit than legislation. In Kelantan, beriberi was, so it seems, imported as a new disease to the Malays, and so long as it existed it seemed to spread by means of a favourable medium—evidently imported rice—but it does not seem to have been brought in by the polished rice that was first imported."

In accounts of beriberi in former days, statements as to "bad" or "mouldy" rice will, the writer thinks, be found as incidents in the history of certain epidemics, but, in view of faith as to the part played by the polished condition of rice, instances in the present day are likely to escape notice. Hence, the accounts by Drs. Gimlette and Chevallier should serve to attract more careful study of the biology and of the influence of moulds on food substances. The facts go to show a "locality disease" in respect to the Hospital incident of Kelantan, as well as the affection of women in the huts after disturbance for clearing, and the freedom of the escort party of the Serenli case. The occurrences in both localities suggest importation in connection with rice—as well as seasonal influence. The history of the "Lodestar" equally points to importation and persistence on board ship, notwithstanding change of crews and cargoes.* Both on board ship and on land once a mould is imported with a grain, the chances would always be that the place used as a store would become infected and, with seasonal changes, the mould would increase and decrease in vitality. Nor would it be right to leave to mouldy grain all possibilities as to destruction of vitamines ; the debris of disintegrated grain might well form a nidus favourable to special animal organisms. The condition certainly warrants further search.

Smallpox.

Preserved Animal Vaccine.

The following is a Report† by J. W. Collett, Acting Principal Medical Officer, Sierra Leone, dated 10th April, 1913, to the Government of Sierra Leone :—

"I have the honour to submit the report called for by the Secretary of State on the trial of 'dried vaccine lymph,' in the Colony and Protectorate of Sierra Leone, and to compare these results with those accruing from the use of 'lanolinated calf lymph' in this climate. . . . . .

"A consideration of the foregoing table will show that both these preparations of vaccine are very active, and give very satisfactory results ; they carry well and retain activity for a considerable time in this climate equally. The preponderance of preference on the part of the medical officers is, however, for lanolinated calf lymph.

"The disadvantages claimed by them for dried lymph are that the entire quantity contained in the hermetically sealed glass tubes has to be utilised

*Smith (E. C. Montgomery). Beriberi-stricken Cases.—*British Med. Jl.*, 1898. Nov. 5. p. 1427.

†*Report of the Advisory Committee for the Tropical Diseases Research Fund*, 1913, pp. 231–232.

at once when the tube is broken in order to ensure the greatest activity of the lymph, a measure that is not always practicable when less than twelve persons can be collected together for vaccination, and that the manipulation necessary for dried lymph is more complicated and not so easy of performance as it is with the lanolinated calf lymph. Dried lymph has to be carefully rubbed up with pure glycerine before it can be successfully used; it does not mix easily with water. Lanolinated lymph is put up in small collapsible metal tubes with screw caps. With this preparation there is very much less waste.

"It is said that although the activity of the dried variety is high, inasmuch as the percentages show, the individual reaction in each vesicle appears to be somewhat greater with the lanolinated variety of vaccine lymph.

"Reviewing the situation, I am inclined to favour the use of the lanolinated calf lymph, because it is apparently quite as, if not more, reliable than dried lymph; it is very much easier to manipulate, it goes farther, and is just as cheap."

The Principal Medical Officer, H. Hearsey, in his Annual Report of the Nyasaland Protectorate for 1913, on this subject states as follows:—"The lanolinated lymph which is supplied by the Lister Institute of Preventive Medicine continues to give every satisfaction."

Selection of Stations in the Tropics.

Granted that sanitary conditions are correctly subserved, is it of advantage in selecting a station for official purposes occupied by "whites" in the tropics that it should be cool, and that to secure this hill sites be favoured? This is a question entered into by Dr. Cameron Blair, in discussing the choice of Kaduna as the future capital of the recently united Provinces of Nigeria, in the following manner:—

"Taking every consideration into account, apart altogether from the central position which so strongly recommends it, it would be difficult in the Northern Provinces to find a better site for a capital: it is over two thousand feet above sea level; it enjoys a dry atmosphere—a most important point in the Tropics—and the nights feel cool during by far the greater part of the year. . . .

It is true that, within the Northern Provinces, it is possible to find sites at a higher elevation—over three thousand feet; but elevation is not everything. . . . In tropical regions, Europeans are apt to direct their attention and preference too exclusively to coolness. Now, railways in the Tropics are apt to make the cool climate of elevated regions a serious danger to health. In the absence of railways, the journey from low to high country is necessarily effected slowly and the system thus is enabled gradually to adapt itself to the changed conditions, but when the change is effected by rail, the shock is apt to be too great—much as the indulgence in a cold bath, which is well known to be dangerous to most Europeans in the tropics. . . . In this country, where the official tour of service only lasts a year, there is no time to dawdle by the way for reasons of health or any other reasons; many people will have to make repeated rapid journeys to the capital, and, under all the circumstances, the site selected for the purpose seems to constitute the happy medium—high enough and sufficiently far inland to afford one of the best average climates in the country, and not so elevated as to render sudden coming and going dangerous to those who take reasonable care of themselves. Again, many men, towards the end of the regulation tour of service, are found to be suffering from valvular incompetence due to dilated heart. This affection disappears after the tonic effect of a few months in the bracing climate of Europe. But for men in this condition suddenly to make the journey from a steamy and relaxing, to a dry and cool climate, and an ascent of over three thousand feet in forty-eight hours, is exceedingly dangerous."

Surgeon-General GORGAS has given such a wonderful lesson in Applied Hygiene in the Tropics in the face of dismal forebodings, that it is not surprising to find that he is an optimist. He states :—"The work on the Isthmus will demonstrate to the world that the white man can live and work in any part of the world, and that the settling of the tropics by the Caucasian will date from the completion of the Panama Canal." (*Statesman*, Calcutta, Jan. 24th, 1914.)

The Administrator of the Northern Territory of Australia, in his Report for 1912, maintains that the development of the tropical portion of Australia by the white presents no insurmountable difficulty, and in this he is supported by Dr. HOLMES.

Sir Havelock CHARLES, in his paper "Neurasthenia and its bearing on the decay of Northern peoples in India," read before the Society of Tropical Medicine and Hygiene,* states that a tropical climate represents for the European a strain on his recuperative powers which exhibits itself by forms of neurasthenia, and that in descendants of pure whites under continuous tropical conditions, race degeneration is constantly evident. He holds that "a main factor in the invaliding of public servants in India is a form of nerve exhaustion, which by lowering their vitality and natural immunity renders them more susceptible to the onset of various diseases."

Dr. Basil PRICE, †in his paper before the meeting of the British Medical Association in 1913, equally pointed to the nervous system as the great point of departure from health of the white in the tropics. Both these authorities have exceptionally large experience in dealing with the question of fitness of the European for service in the tropics. In India, at least, medical opinion would support Sir Havelock Charles' view that to meet the strain of official work the European must be of a selected type.

Thus, there are two widely different current theories, and it concerns the practical sanitarian, as shown by the quotation as to selection of sites, to gauge the applicability of one or the other.

The fact that, under altered sanitary conditions, European life has improved in India is shown by the following figures, which, unfortunately, it is not possible to support by those applicable to a later date. The Royal Commission, 1859–63, found that officers of the military forces died at the rate of 31 per mille, soldiers 69, European civilians 20, and that the mean after lifetime of Europeans resident in India was shortened from 21 to 28 years. CORNISH (a former Sanitary Commissioner with the Madras Government) in statistics ranging from 1848 to 1872, found that officers of the Indian Civil Service died at the rate of 14 per mille, but that in the twelve years ending 1873, the rate was reduced to 11 per mille. In contrast he shows, as exemplifying the risks of duties and habits of other officers of the latter period, that officers of the Indian Medical Service died at the rate of 15·7 and of the Indian Staff Corps at 18·04 per mille. But Sir Havelock Charles does not dispute the importance of improved sanitary conditions in modifying the death rate of whites in the tropics. In supporting his opinion, he stated :—"If you damage

**Trans. Soc. Trop. Med. & Hyg.*, 1913. Nov. Vol. 7, pp. 1–31.

† Discussion on the Causes of Invaliding from the Tropics.—*Brit. Med. Jl.*, 1913. Nov. 15. pp. 1290–1293.

the subservient systems, you injure the whole animal, *i.e.* the nervous system. Tropical climates injure the various systems of the body apart altogether from the dangers of attack from parasitic enemies."

The writer thinks that the opinions are reconcilable, by it being held in mind that the favourable death-rate secured by Gorgas in Panama was largely that of a floating population, whereas the facts referred to by Sir Havelock Charles are concerned with " continuous service " in the tropics. The latter may imply residence, with short intermissions, of thirty or more years in a hot climate, under official " strain." There is not suggested incompetency of the selected European to fulfil his duty, but simply that he does so at a greater expense of physical and mental strain than if he were in a temperate climate.

Now the word " strain " requires interpretation. It involves the plain fact that the European in the tropics earns such bread as he gets " by the sweat of his brow." In all tropical countries where administration is incompletely built up, this must be expected ; one reform follows another, not with the leisurely pace of England, when expanding its long established rulings worked by organizations mellowed by time, but so as to cover not one but a dozen duties of staffs that are yet to be created in order to secure a single end. The staffs used though sufficient at one stage of progress are apt to be inadequate in the next, whilst public finances may be insufficient quickly to strengthen them. This well known, and practically unavoidable, sequence of events in unsettled countries is thus adverted to in the Report on Northern Nigeria. After referring to the mistake of failure to provide sufficient house accommodation for Europeans, the Principal Medical Officer adds :—

" With the amazing development of the country, it is inevitable that certain departments, in order to overtake the stress of work, should have to work overtime. Against that I have nothing to say : but when the overtime becomes almost a matter of ceaseless routine up to the hours of darkness, I think it should be a subject for enquiry. It is not fair on the clerical staff. The habit of physical exercise and recreation is a very valuable asset towards keeping a man fit and sane—to some absolutely essential."

The necessity for employing a selected type of European to meet, under tropical conditions, official strain has been interpreted by some lay papers in India as a reason why the European should be further replaced by the Indian. This calculation is, however, beyond the premises of *selection for special work*, and the belief that when the type yields, it does so in a particular manner. The writer is of opinion that whilst in the lower grades of official life in India the bulk have far less duty expected of them than of the commercial classes in Europe, in the higher grades, where responsibility and energy are required, the Indian official is subjected to no less strain than the European and, speaking in the absence of statistics, breaks down under it in greater proportion than the selected white.* *Inter alia*, they are notoriously liable to diabetes, which although conduced to by their special diet and habits, is probably primarily, in this class of case, a mere symptom of loss of nerve control over physiological processes—

* This subject has attracted the attention of the Madras Government : Dr. S. W. Patterson (Beit Scholar) proceeds to Madras for three years to investigate it.

often, in our personal experience, as temporary as the neurasthenia of the European, should changed conditions of life be prescribed.

If, then, in judging the fitness of the white for service in the tropics, it is necessary to regard the matter from the point of duration of residence as well as nature of duty exacted, it would be advisable to do so under conditions devoid of disturbing insanitary factors and official strain, and thus arrive at the influence of climate on the human organism.

Experiments fulfilling these requirements have been undertaken by the "Board of Studies of Tropical Diseases in the Philippine Islands," as reported by Major Weston P. Chamberlain, M.D., U.S. Army.* 1,000 soldiers were under close observation by specially trained medical officers during 1909–'13. As to the hygienic circumstances of these subjects, Chamberlain states: "It is my opinion that nowhere else in the tropical world, except perhaps in Panama, can there be found a collection of men living under such a high degree of hygienic protection as is accorded to the American soldiers serving in the Philippine Islands." He further adds:—"The individuals on whom this report is made had not all been in the tropics for equal periods of time. At the date the men underwent their preliminary tests, the average duration of Philippine service for the group was seven months. The observations were repeated at quarterly intervals for one year, so that at the date of the terminal examinations these soliders had resided, on the average, for 19 months in the tropics."

Investigations were of the most elaborate character, and embraced observations of temperature under conditions of rest and exercise, contrasting the brunette with the blonde, respiration and pulse rate, blood pressure, body weight, blood as to haemoglobin readings and erythrocyte count, urine, and condition of nervous and digestive systems. In summing up results, Chamberlain arrives at the conclusion that, granted the observations exhibit differences between normal conditions in temperate and tropical climates, they are so slight as to be negligible, and states finally:—"The facts justify the hope that the progress of tropical sanitation may ultimately permit the permanent colonization of certain parts of the tropics."

Now, whilst this conclusion may be correct as to the white serving for short periods in the tropics, the observations may have a different interpretation if applied to "continuous service," in that differences from the normal in the short service may by persistent action in "continuous service" represent important influences. Putting aside loss of weight (1·3 per cent. in 19 months) and the erythrocyte count (which presents small but interesting peculiarities *in the direction of an approach to the blood state of the indigenous native*, and is to be further enquired into), the only more obvious alterations found are in the respiration and pulse rates, and blood pressure. Thus, accepting throughout American standards for normal rates, it is found that, for the year, the average pulse rate per minute was 77·3 against the normal 72 to 75; respiration was 19·0 against the normal 14 to 18. The yearly average systolic blood pressure, for 229 men of the average

*Some Features of the Physiologic Activity of Americans in the Philippines.—*Amer. Jl. of Trop. Diseases & Preventive Med.* 1913. July. Vol. 1, No. 1, pp. 12–31.

age of 25·3, was 115·8 mm. We select this observation, as it alone exhibits the influence of seasons in the same year (1909). This average was, practically, the same as for Filipinos of twenty-five years of age (115·5), but does not accord with the only normal average quoted for whites in America, namely, 119 mm. of BUCHANAN of Philadelphia. But whilst the yearly average of such experiments has a significance, it is to results in the hottest periods of the year one would look for indications of changes under continuous climatic conditions ; this, in the Philippines, would be in the month of May.

Here we find that in 1910, of three quarterly observations on men of average age of 27·7 years for the period commencing May, the blood pressure was 117·1 against 117·8 for the cooler November period. In 1911, only two readings were recorded, namely, for the February period 117·5, whilst the pressure for May was 0·2 mm. greater. The observation, however, lacks the contrast of the cooler months in the same year. So far the hottest month indication of lowest pressure is weakened, but gathers strength again in a further observation on men of average age of 25·3 years, when the pressure for May is 113·9 against 117·5 for December. Another set of observations is recorded upon 991 men, according to length of residence in the tropics, in groups of from three months to twelve months, and should be of special interest, but, the writer thinks, results are vitiated by the fact that they are arranged according to age and not according to length of residence of that age.

Chamberlain gives the average pulse rate for 608 men at 77·3 and respiration rate at 19·3, but again May, in both 1910 and 1911, shows the greatest departure from the average, although the figures are not, as in the pressure observation, consistent. In May 1910, the pulse rate was 77·8 and respiration 19·4, whilst, in 1911, the pulse rate was 77·1, and respiration 19·2. Chamberlain then observes—" the average rate of 77·3 heart beats per minute is a little above the standard of 72 or 75, which has been established for temperate climates. The respiration rate of 19·3 is quite noticeably rapid, if one accepts the standard as 14 to 18 for cool countries."

Definitely, therefore, the influence of tropical when contrasted with a temperate climate is to increase the heart and respiration rhythm ; there is also a maximum disturbance of systolic pressure in May, the hottest month, in two succeeding years. If the incomplete observations for 1911 be put aside and those of 1910 only be trusted to, it is found that, in May, the systolic blood pressure is at a minimum and the pulse and respiration rate at a maximum, whilst at all periods these two rates are above the temperate climate normals. Granted that these variations may be of no great moment in men of an average of nineteen months' residence, when applicable to those of " continuous service " treated by Sir Havelock Charles, the extra work demanded of the heart per minute multiplied by years and subject to increase during exertion may imply results that may not be trivial.

Now it is usual, as Chamberlain has done, to refer to rarefied air as at the root of increased respiration and heart action, but the writer ventures the theory that the direction in which to look for the primary strain in the white is the vaso-motor control. In judging of these results, we must premise with Sir Havelock Charles that the white is a special

product of ages in a temperate environment, and consequently the approach to a blood count or blood pressure normal to, say, a Filipino as found by Chamberlain, may be abnormal to the white in the same locality. The facts of the case are probably missed by the use of a measure of systolic blood pressure as against the observation of the effects upon the auxiliary heart (represented by the muscular and elastic fibres of the arterioles) of that pressure and its regulation in the peripheral circulation, which the defunct sphymograph aided in interpreting by the tracings of the diastolic period. Given dilatation of the skin capillaries day by day for years on end under tropical heat, the vaso-constrictor mechanism is less often caused to function than in temperate climates; and it is conceivable that by lapse of time the control of nerve matter and involuntary muscular fibres may become less efficient by disuetude, and by consequent less demand in physiological nutrition processes for the selection of vitamines for nerve nutrition—in the first place of vaso-motor centres. Hence there arises less ability to cope with sudden demands that mean "strain"—by prompt adaptation of blood pressure. From such a starting point, it would be possible to account for a heart, at the first stage with diminished systolic pressure, owing to dilated arterioles increasing its rate in overcoming an approach to capillary stasis thus favoured, with respiration sympathising, and for the nervous system in the white long resident in the tropics proving an ill-nourished and vulnerable point.

Chamberlain's Report declares, as to men of 19 months' residence in the Philippines, that there is no material difference as to diseases of the nervous system when compared with the United States, but that in men who have been resident for over five years "sensations complained of were of slight degree and perhaps in many cases fanciful." These complaints included loss of memory, insomnia, depression and irritability. Of the genuineness of these complaints he must be the best judge; but one is not disposed to regard an excess under nervous diseases, when compared with the United States rate, to the extent of 1·87 per mille, in men of only 19 months' residence, as without indication of the direction in which climate strain tells.

These elaborate and valuable American observations have cleared so much ground as to the climate factor during short residence of whites in the tropics that they should enable attention, in the future, to be concentrated on physiological functions not in terms of annual averages but during periods of extremes of heat, as tending to interpret the strain of *continuous* service. Admittedly, the vaso-motor theory, so far, has but small grounds for support.

This discussion is prolix but, nevertheless, has a relation to Dr. Cameron Blair's choice of site. His caution as to influence of sudden change of altitudes upon "tropical heart" is undoubtedly judicious where not a sanitorium but an official business centre is intended, implying short visits and rapid transit. At the same time, experience in connection with hill stations up to 7,000 feet, now accessible by rail in India, which are used chiefly for residences of a few months in the hot season, would show that collapse attributable to this cause must be very rare. There are, however, a certain number of persons who find inconvenience in change of pressure at even 3,000 feet, with headache and breathlessness under exertion for a few hours.

Finally we would draw attention to the predilection in choice of sites shown by the demand of an elevation sufficient to afford "cool nights," as stated by Dr. Cameron Blair. We think an important distinction must be made on this point. The desire is founded on the common experience that the staying powers of whites are better where the dilated state of the arterioles has a temporary respite in contraction under a few hours' cool temperature per day, provided the diurnal contrast is not excessive, and it is on this, apparently, that the best hope of white colonization of tropical parts of Australia is founded. The following extract from the preface to the Annual Medical Report for the East Africa Protectorate (1912) shows that indigenous tropical races have not a predilection for "cool nights." Notwithstanding the abundance of arable land, the Principal Medical Officer states :—"It is a curious fact, and worthy of note, that all these regions most sought after by the white and Boer immigrants were, with the exception of the fringe round Nairobi, the areas least inhabited by a permanent native population."

SANITARY LEGISLATION AND RULINGS.

Town Planning.

In their G.O. No. 1069 M., dated 10th June, 1912, the Government of Madras " in order to ensure that schemes for the extension of towns and the provision of house accommodation undertaken by Municipal Councils are carried out with strict regard to sanitary principles " have proposed a set of rules for the guidance of these bodies. We select a few of them as useful for general application in sites intended for non-European populations :—

1. No scheme for the extension of a town or for the acquisition of land for the provision of house accommodation shall be undertaken by a municipal council unless the site selected by it for such extension or acquisition has been previously approved by the District Medical and Sanitary Officer or the Sanitary Commissioner with special reference to the suitability of the soil for building construction, facilities for drainage and water-supply and other matters.

. . . . . .

3. Roads and streets shall be marked out on the site and shall as far as possible run in straight lines crossing one another at right angles. The main roads exclusive of lateral drains shall be not less than 40 feet in width and the secondary roads not less than 30 feet. In the case of long roads, cross roads shall be provided at intervals of from 1,000 to 1,500 feet so as to secure perflation of air and easy exit.

. . . . . .

5. Conservancy lanes 10 feet in width exclusive of lateral drains shall be formed along the backs of houses to enable conservancy carts and scavengers to enter for the purpose of cleansing backyards and for the laying of drainage pipes in the event of the town being provided with underground drainage.

. . . . . .

7. The formation of roads, streets and drains must form part of the scheme for laying out the site and should ordinarily be put in hand simultaneously with the execution of the scheme instead of being deferred to a future date.

8. In all cases where the width of the main streets exceeds 30 feet municipal councils shall, as far as possible, plant and maintain suitable avenue trees on both sides of the street.

9. Suitable places for the construction of public latrines shall be selected and set apart for the purpose.

10. Where there is no pipe water-supply, suitable sites shall be selected for the sinking of wells.

11. The land acquired for the extension of a town shall be plotted into house-sites, the size of which shall ordinarily be not less than 45 feet by 60 feet. The sites so laid out shall be sold in public auction subject to such conditions and penalties for failure to comply with them as may be stated in the sale-deed.

12. Purchasers of building sites shall, by a stipulation in the sale-deed which shall also be embodied as a condition in the notice of sale published by the council, be required to complete the construction of their houses within a period of one year from the date of purchase on pain of forfeiting their right to the property without any compensation, if they fail to do so, provided that the municipal council may, for special reasons, grant an extension of time.

13. No house-sites shall be built upon unless and until the purchaser submits a plan of the building to the municipal council and furnishes

the particulars required by section 180* of the Madras District Municipalities Act, 1884, including—

(*a*) a statement showing the dimensions of the building and the levels at which it is intended to lay the foundation and lowest floor ; and

(*b*) a statement showing the means of ventilation and drainage and the privies which it is intended to provide.

14. No sub-division of house-sites or construction of more than one house on each site shall be permitted.

15. Houses shall be constructed with frontage facing the roads and streets.

16. The construction of houses lying back to back shall be strictly prohibited.

17. No house or outhouse shall be under any circumstances be allowed to be constructed with thatch.

18. The main walls of the house shall not be less than 10 feet high. The eaves must not be less than 8 feet above the plinth.

19. The provision for ventilation shall comprise suitable windows in each room.

20. No house shall be built on a basement of less than 2 feet from the ground and such basement shall be of masonry or some rat-proof material.

21. All backyards of houses shall be provided with a gateway so as to give access to municipal officers for the purpose of inspection and to the private scavenging staff.

22. All backyards of the houses shall be provided with suitable impervious bathing platform for the inmates of the house. Each house shall be provided with a latrine to be made to a standard pattern supplied by the municipal office.

23. All sullage water from a house and its backyard shall be drained into the municipal drain in the conservancy lane and not into the drain in front of the house which is provided to carry off storm water.

24. All cattle yards shall be flagged and properly drained.

25. All houses shall be enclosed by durable compound walls or fences of such description as the council may prescribe.

26. Except in so far as may be necessary for the excavation of foundations or wells or the levelling or sloping of the ground, no purchaser of a house-site shall remove earth from the site for building or any other purpose so as to leave hollows in it.

27. Rules 12 to 26 *supra* should also be embodied as conditions of sale

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*This Section runs as follows :—

" Every person intending to construct, re-construct or extend a well or a building (other than a mere wall) shall, six weeks before beginning to construct, re-construct or extend it, make an application in writing to the Municipal Council for a license to do so.

Such application shall be accompanied by such particulars as the Municipal Council may require under by-laws framed in this behalf, and shall further be accompanied,

(i) in the case of buildings, by

(*a*) a plan or statement showing the dimensions of the building and the levels at which it is intended to lay the foundation and the lowest floor ; and,

(*b*) a statement showing the means of ventilation and drainage and the privies which it is intended to provide ; and

(ii) in the case of wells, by a statement showing the dimensions of the well, the manner in which it is to be fenced and, if the well is to be used for drinking purposes, the means which it is intended to take to prevent pollution of the water." [" Drinking Purposes " does not fully meet requirements of sanitary protection. The Act is now under revision. W. G. K.]

in the notice of sale published by the council and in the sale-deed before possession of a site is given. In case of breach of any of these conditions the council shall call upon the owner of the plot to make the necessary alterations or provision within a period of three months, in default of which the municipal council shall be authorized to make them itself and recover the cost from the owner.

28. No relaxation of rules 14 to 26 shall be permitted without the prior approval of the Sanitary Commissioner which will be given only on special grounds.

Railway Stations and Town Sites.

The following rulings have been approved by Sir F. D. Lugard, Governor of Nigeria, as to sanitary inspection of railway stations and town sites :—

1. "That the Director of Surveys, the Chief Engineer of the Railway or his lieutenant, the Residents of the localities respectively concerned, and the Senior Sanitary Officer should systematically visit every station throughout the railway system, whether or no actual activity was contemplated thereat, and arrange the lay-out of the station-yard and buildings, the railway area generally, the Traders' siding plots, the European residential quarter, the non-European alien quarter and the native location.

2. That each station so visited should be set out by the Director of Surveys and a plan thereof prepared by him.

3. That any difference of opinion touching the lay-out as shown on the plan should be submitted to his Excellency.

4. That the plan, when finally signed by His Excellency, should become the Official one.

5. That such plan should be filed in the office of the Director of Surveys, and copies in the office of the Chief Engineer of the Railway."

Mahomedans and Segregation of Lepers.

In Northern Nigeria the Principal Medical Officer states that in 1913 there were 243 lepers admitted to camps. The Chief Sanitary Officer whilst acknowledging the helpfulness of the Mahomedan community in forwarding his sanitary recommendations advises tact in pushing segregation. This caution is desirable, but at the same time it is a subject on which Mahomedans should have no hesitation upon religious grounds. Thus, Abu Daood has recorded in the Bukhari the following traditions of the Prophet's sayings as to leprosy :—

(1) "Whenever you come across a leper, flee from him as you would from a lion."

(2) "Talk to a leper in such a manner that the distance between you and him be no less than the length of two spears."

(3) "Do not eye the leper closely."

TREATMENT OF WASTE.

Makeshift Conservancy.

The dry earth committal of foecal matter by the feline tribe meets presumably the special requirement of preventing alarm to their prey by tell-tale odours. It is typical of methods for early nitrification of foecal matter, which both the sanitarian and agriculturist would desire. It is fully recognized under the sanitary laws laid down by Moses in Deuteronomy, chapter 23, verses 12 and 13, thus :— "Thou shalt have a place also without the camp whither thou shalt go forth abroad, and thou shalt have a paddle upon thy weapon, and it shall be when thou wilt ease thyself abroad thou shalt dig therewith, and shalt turn back and cover that which cometh from thee." Mohamedans recognize Moses, and we understand that those of scrupulous principles occasionally show adhesion to this mode by having at the end of their sticks or staves small spuds for formation of excavations. The official "on tour" as it is termed in India, or "patrol," as is apparently recognized in some of our African colonies, resorts in camp life not infrequently to modification of the same principle. It is, in fact, the most inoffensive and rapid method of disposal yet excogitated.

Many years back the writer inaugurated, under the term "Jewish conservancy," a modification of the system for public use, which was readily resorted to by Indians at festivals. The space required is such that in large assemblies it will be possible to use it only on the outskirts of a town for a surplus of people not otherwise provided for. It recognizes the fact that persons without discipline will not make holes but will use them if provided, and that most will not take the trouble to cover the hole after use, so that this also must be done for them. The method gives considerable privacy, as any hole can be chosen, and any position assumed, and as the arrangement is cleanly and odourless, there is nothing to offend the sense of sight or smell of the user. It is, necessarily, not a method that can be relied on in rainy seasons, and presupposes plots of ground readily penetrable such as are found in fields that have been cultivated.

Certain of the Medical and Sanitary Reports in Africa show that at railway stations and market resorts, where conservancy for normal traffic is provided, large numbers of "bearers" or labourers suddenly appear on the scene. In such cases, as well as in camps for engineering "construction works," which shift from time to time, the method should be useful, as the latrine boy would, in good soil, have a lighter task in preparing holes than in carrying buckets for distant disposal, cleansing, and returning them. The method worked in connection with any institution having arable ground at disposal, so as to use plot after plot of ground, would place excreta economically in the best possible position for quick nitrification, and enrich the ground for subsequent cultivation. The following is a description of the method as applied to construction works camps :—

"A place is marked off in a field, conveniently close to the works—say, not exceeding 100 yards distant—by means of four flags. Within the square space so selected are made pits, at distances of three feet from each other. These pits measure six inches in diameter, and eight inches

in depth. On one side of each pit is placed the earth excavated from it, and a piece of split bamboo two feet or so high, having a small coloured rag at the end, is fixed at the same side as the piled earth. On the side nearest the works, is placed, so as to preserve the sitters from observation, a moveable screen, which may be made of jungle tree branches intertwined with any foliage that will secure protection from sight. It is necessary to retain a man on duty on the site throughout the working hours . . . He will see that defaecation occurs in the holes *only. The moment a person retires,** it is the attendant's business to proceed to the hole used, and remove the split bamboo—showing that the hole is not to be again used—and with the movement of his foot to throw the earth, piled as stated above, into the pit. If the attendant be too "nice" to do this himself, there is no reason why, without much pressure, he should not be able to convince the person who has used the pit, that it is his duty to move the earth with his foot, and thus cover the excreta."

The pits can be made by a crowbar or pickaxe, but such holes are liable to be irregular in size, and consume time in the making. The use of a special spade is therefore advised. This has for the blade a form similar to that of a garden trowel and is provided with a shaft of plain iron, with a bar at right angles for the foot in using pressure in penetrating the earth. The trowel portion should preferably be made of steel, and have slightly sharpened edges. With this spade it is possible to make a pit by two movements—each cut making half.

Rat-proof Dust-bin.

As a measure against plague, Dr. Arthur Stanley, Medical Officer of Health at Shanghai,† recommends a house refuse receptacle of the automatically closing type so as to prevent access of rats. He states that it is the outcome of "years of experiments" and that its use has secured a "marked improvement in the cleanliness of alleys." He thus describes it:—

"The approved form of receptacle is made of brick and cement concrete, is three feet long by two feet deep, with a sloping top having a small door which cannot be opened beyond the vertical and so automatically shuts itself after house refuse has been emptied in; and having an iron door at the side with a special fastening of which the house refuse removal coolie only has the key and through which refuse is daily removed. These receptacles have been erected by the sanitary staff, the property owners providing the necessary materials, which cost $6 for each receptacle."

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*The man must be distinctly obedient to this instruction. The tendency is always to lessen journeys by allowing several holes to be used, and then covering the lot—thus effectually frustating the object of not offending sight or smell of users.

† Shanghai Municipal Council, Health Dept. Annual Report, 1912.

SANITARY WORKS.

Anti-malarial Works.

The following, from the Senior Sanitary Officer's Report for Northern Nigeria for 1913, illustrates the use of a syphon for aiding drainage :—

At Baro, "the swamp was really effectively tackled at last, by the Assistant Locomotive Superintendent, who devised a cunning syphon arrangement, which at low level effectively drained the lower aspect into the Niger. In connection with the upper aspect, where the marsh water stands at two levels, arrangements were made to cut a drain from the higher to the lower level."

In the Annual Report for 1912, on the Medical and Health Department in the Colony of Mauritius, the Sanitary Engineer, J. Lois Naz, states the following anti-malarial works have been executed :—

"On the Mount Estate, there was a marsh of several acres, caused by a dyke having been built across the Pamplemousses River, from which the factory drew its water supply. The dyke was removed, and a deviation canal with an intake higher up the stream was built to feed the factory. The marsh was then drained by means of a central trench, cleared of rushes and aquatic vegetation, and is now being cultivated.

On the same estate, as well as on the one above the river, the Pamplemousses River had no proper bed, with the result that along its course aquatic vegetation and marshes existed. A proper bed large enough for flood waters and deep enough to dry the banks where thick vegetation existed, has been provided. Three thousand feet of marshy jungle is being done away with and will be soon under cultivation. Work of a similar nature is being done along the same river and will be reported upon later on. . . . At Long Mountain, an extensive marsh existed along the Ruisseau Meunier known as "Sanassee" marsh. This was drained by sinking the stream bed running through it; and, as no proper bed existed, either up or down stream, on a total length of two thousand five hundred feet, causing marshes all along, the sinking of the bed was also carried out there." . . . "At Flacq, twelve hundred feet of solid rock had to be blasted at a depth of ten feet below surrounding ground to provide an outfall for the centre of Flacq marsh. The rock being fused, lava was especially hard to deal with, and five thousand dynamite cartridges had to be employed during the operation."

Sanitary Surveys and Engineering Aid.

The following is an Extract from a Madras G.O. No. 917L, dated the 2nd August 1904, to which we have referred in our Note on "Malaria in Bengal" :—

"They therefore accept his [the Sanitary Commissioner's] statements, that the campaign against malaria to attain any fair measure of success must include not only the destruction of mosquito larvae on pools, but also administration of quinine, and minor engineering works to relieve the surface and subsoil water flow. They are disposed to place particular trust on well considered measures of the latter nature, as tending to the securing of radical results. The Government are accordingly prepared at once to see effect given to the scheme as a practical portion of the regular sanitary programme in every municipality and throughout the jurisdiction of every Local Board in the Presidency . . . When the scheme sanctioned in G.O. No. 1558L dated the 7th December 1903, comes into operation, the District Medical and Sanitary Officer will have at his disposal a subordinate capable of drawing up plans and estimates for minor sanitary engineering works, such as would be required in an anti-malaria campaign. Pending the appointment of this additional staff, District Boards should, for such time as the District Medical and Sanitary Officer shows necessity, place directly under his orders an engineering subordinate capable of levelling, drawing and making estimates in respect to works of the minor nature required. Necessary instruments and lascars should be provided."

Delta Land Reclamation.

Reclamation of marsh land by silting is a process that requires much time combined with continued engineering supervision, to secure that the new land should have the necessary gradient for permanent drainage works.

Temporary aggravation of malaria conditions during the process, until drainage is unquestionably established, may occur. Silting is by no means new to India. Indians along the Godaveri have long formed islands on the stream bed by silting within palasading formed by grass and trees. In Ootacamund, a considerable portion of the present gymkhana ground was recovered from a lake by this method; and in the hands of irrigation engineers in Southern India, the training of silt-bearing streams by using the tree and grass known in the vernacular, respectively, as "neer nutchi" and "nannal" is commonly practised. As stated in another Note in this issue, an establishment must be maintained for regulation of silting; hence, the modern method of land reclamation by pipe-line hydraulic dredgers in situations approachable by rivers and canals rich in silt is preferable. The method is peculiarly suitable in delta land reclamation, for not only is it possible thus to restore waterways and build embankments, but to fill the neighbouring marshy lands and to raise the level of areas. Thus the Ellicott Machine Co., of Baltimore, and the Morris Machine Works, Baldwinsville, U.S.A., furnish dredgers which can deliver silt or stiff clay to distances of over a mile with a lift of 25 feet. Certain of their machines have dealt with suitable material at the rate of 7,000 cubic yards for 24 hours. Such dredgers of course deal chiefly with sand or silt, but are not put "out of duty" by dealing for long periods with gravel and boulders. The raising of the level of Galveston, in America, was one of the first instances of dealing with a large area intended for buildings.

Apparently the utility of these machines in performing the duty at once of clearing silt and elevating land is not being contemplated in Bengal, as we find in estimates for clearing the Bidyadhari that there is a heavy and progressively increasing item for rental or purchase of ground for embankments and for storing silt that has been dredged. Yet it would seem unlikely that even in this particular area there is no suitable locality for elevation, or for filling, or that in many parts of Bengal the function of clearing the beds of rivers and of canals could not be profitably combined with land reclamation, within a mile or more of portions dredged.

In Burma an excellent start in this direction has already been accomplished. Along the navigable creeks which are off-shoots of the Irrawaddy are Municipalities where busy trade is conducted at elevations perilously near tidal action, so that, the houses are built on piles over water. Here, the raising of sites is of the greatest importance sanitarily, and is also likely to be profitable by land reclamation. In Pyapon, in Burma, 147 acres of a total of 300 sanctioned for reclamation have been completed by this method, and whilst warning that no formal mosquito survey has yet been carried out by the Sanitary Department, and that this must be awaited for final opinion, the Superintending Engineer, P.W.D., Pegu Circle (Govt. of Burma) has reported officially that the inhabitants are fully agreed that there

has resulted a marked reduction of mosquito prevalence. His personal opinion is thus stated: "When I next visited Pyapon, in April, 1913, and when reclamation of the Civil Station was completed, there was distinctly less number of mosquitoes and I suffered little inconvenience from sitting outside a mosquito-proof room after dark. When I again visited Pyapon in February * last (1914) there were hardly any mosquitoes at all. There is not the slightest doubt that the place has been greatly improved and that owing to the destruction of these mosquitoes fever is less prevalent." On completion of the Pyapon work, the site of the Municipality of Kyaiklat has been undertaken. The Superintendent Engineer states: "The sanctioned estimate provides for (Kyaiklat) for the reclamation of about 90 acres, out of which about 46 acres have been done up to date. There is already a marked improvement in the health of the people. . . . . A small portion of Bogalay town has also been reclaimed up to date. It is proposed to reclaim the following towns in the Delta in the near future, if funds allow:—(1) remaining portion of Pyapon town; (2) Bogalay; (3) Dedaye; (4) Mawlamyaing; (5) Wakema."

There are few delta lands where this modern method would not prove of great utility; it is possible that a combination on a large scale of dredging silted rivers, embanking, and pumping might prove advantageous in preparing areas for cultivation in the still unused and more recently formed portion of the Bengal delta, and in protecting by these measures against future invasion by malaria (in judiciously selected sites) they might prove remunerative as productive engineering works. As a small instance of reclamation we would point to the drainage of swamps near Calcutta in the canal area, as having increased four and five times the value of the land. Except near towns such value will doubtless be exceptional, but it is worth remembering that there are over ten millions of acres of land classed as cultivable in Bengal *which are not so utilized*, some of which is probably near silted rivers.

Village Water Supply.

To supply the average village in the tropics with a well in a correctly selected site, and constructed so as to be safe from surface and subsoil pollution is but part of the problem of sanitary protection, for there still remains the difficulty of contamination during water withdrawal by hands, feet, vessels, ropes, etc., and direct entrance of impurities by the mouth of the well. The mosquito has also to be guarded against. Hence the universal precaution of providing a cover. Putting aside lifting of water by mechanical means on behalf of groups of inhabitants, the usual desire is to secure a mechanical arrangement that shall be worked by individuals on their own behalf. For Indian caste people there must be no leather in the apparatus, and, for villagers of all countries, it must be practically unbreakable. Hence, an experiment by the Madras Government to supply at least one fully sanitarily protected well for each village in these Districts will be watched with interest. It has been resolved to use semi-rotary pumps for lifting. This choice of form of pump meets many objections, and it is certainly little liable to get out of order under reasonable treatment. But, in rural areas, the ordinary fate of any form of lifting

* This is a season favourable to prevalence.

apparatus is to be put out of action by some simply acquired defect, and therefore to be abandoned as useless. The centre of the Madras scheme, however, is that this fate may not befall the semi-rotary pumps; as itinerant mechanics will be appointed for reasonably large areas, who will be responsible for repairs.

Well Boring.

In some tracts in the tropics it is not uncommon to find sweet and brackish water within a few feet of each other—a matter incident upon soil and subsoil configuration, and its previous history in formation. It is hence a matter of disappointment to excavate a well only to find it hopelessly brackish. For depths of ordinary shallow wells, in the absence of rock, the driving of a Norton's tube well—to be afterwards withdrawn—suffices for exploration and test of the quality and supply of water at disposal. After that depth, tube-well driving, although feasible, ordinarily gives place to boring. Hence the Madras Government have arranged that District Boards should send subordinates to a class of instruction to be held twice yearly by their Sanitary Engineer, with the object of boring methods being explained. They anticipate economy will result by more full use of preliminary boring. They advise each Board to purchase the following apparatus. As the list may prove useful elsewhere, we reproduce it :—

Estimate for a set of boring tools and plant for District Boards to bore to a depth of about 50 feet in all classes of soil up to hard rock.

Item number.	Quantity.	Description of tool or plant.	Rate.	Per.	Amount.	Total.
			Rs. A. P.		Rs. A. P.	
1	1 ... No.	Open (clay) auger, 2½ in. size	30 0 0	Each.	30 0 0	
2	1 ... ,,	Worm do. 2½ in. ,, ...	30 0 0	Do.	30 0 0	
3	3 ... ,,	Nose shell auger, 2½ in. ,, ...	42 0 0	Do.	126 0 0	
4	1 ... ,,	Flat chisel, 2½ in. size	14 0 0	Do.	14 0 0	
5	1 ... ,,	V do. 2½ in. ,, ...	15 0 0	Do.	15 0 0	
6	4 ... ,,	Hand dogs, 1 in. size	7 0 0	Do.	28 0 0	
7	1 ... ,,	Lifting dog, 1 in. size	15 0 0	Do.	15 0 0	
8	1 ... Set.	Tiller rods with screws, complete ...	22 0 0	Set.	22 0 0	
9	1 ... No.	Swivel rod (short), 1 in. size	15 0 0	Each.	15 0 0	
10	4 ... ,,	Lengthening rods, 10 ft. long each and 1 in. square.	15 0 0	Do.	60 0 0	
11	1 ... ,,	Lengthening rods, 5 ft. long each and 1 in. square.	14 0 0	Do.	14 0 0	
12	54 L. ft.	Boring pipes. 3 in. internal diameter and ¼ in. thick; screw joints, flush inside and outside.	4 8 0	L. ft.	243 0 0	
13	2 ... Sets	Pipe clamps or rests (long type)	24 0 0	Set.	48 0 0	
14	1 ... No.	Bell screw or bell box	30 0 0	Each.	30 0 0	
15	1 ... ,,	Crows foot	15 0 0	Do.	15 0 0	
16	2 ... ,,	Four-ton lifting bottle jacks with wrought iron cylinder.	15 0 0	Do.	30 0 0	
17	1 ... ,,	Iron pulley	5 0 0	Do.	5 0 0	
* 18	1 ... ,,	Wooden platform	30 0 0	Do.	30 0 0	
* 19	3 ... ,,	Casuarina or similar poles, 25 ft. to 30 ft. long.	...	L.S.	10 0 0	
20	2 ... ,,	Manilla rope coils, 50 ft. long and 3 in. circumference.	8 0 0	Each.	16 0 0	
21	1 ... ,,	Monkey spanner, 12 in. size	4 12 0	Do.	4 12 0	
22	1 ... ,,	Do. 10 in. ,,	4 8 0	Do.	4 8 0	
* 23	1 ... ,,	Mamooti	1 0 0	Do.	1 0 0	
* 24	2 ... ,,	Crowbars, 5 ft. long	1 8 0	Do.	3 0 0	
* 25	1 ... ,,	Cutting knife (billhook)	2 0 0	Do.	2 0 0	
* 26	1 ... ,,	Clay auger cleaner	0 8 0	Do.	0 8 0	
* 27	1 ... ,,	Rose shell do.	0 8 0	Do.	0 8 0	
28	1 ... ,,	Measuring tape, 50 ft.	4 8 0	Do.	4 8 0	
		Total ...	...	...	816 12 0	
		Add for freight fluctuation of prices, etc.,	...	L.S.	183 4 0	
						1,000
				Grand total of estimate ...		1,000

Note.—The items consist of all the required outfit complete. Items marked * may be had or made locally.

VITAL STATISTICS.

In opening his Administration Report for 1912, the officiating Sanitary Commissioner for the Punjab, Lieutenant-Colonel Browning-Smith, I.M.S., discusses the vexed question raised by the Government of that Province in their Review of the Report as to the using of " estimated populations " in compiling vital statistics for the Province. He shows that if the estimated population were employed, the total death rate for the Punjab of 25·9 per mille would be reduced by 0·7, and the birth rate of 44·1 would be 1·2 per mille less.

Whilst fully recognizing the value of the method, the Sanitary Commissioner fears that the departure from uniformity with the vital statistical returns from other Provinces would cause inconvenience. This has been the usual method of regarding the matter, and a protest to this end was made some years back by the late Army Sanitary Commission when the method was brought into use by a Sanitary Commissioner with another Government in India. It obviously would have been troublesome to them, as a preliminary to any criticism they wished to make, to have to verify the estimated population at periods for each Province as a whole and, at times, of localities. Moreover, in the present condition of inaccurate registration of vital statistics they must have felt, as probably does Lieut.-Colonel Browning-Smith, that the labour would be largely futile.

Unfortunately, there is in India another objection which forces itself on notice, namely, that epidemics are still imperfectly dealt with, and that in a country so largely dependent on agriculture, and this again upon wayward monsoons, there can be few successive periods of ten years in any Province when the rate of increase of a population is more than approximately that of the previous intercensal period. For example, the death rate for the quinquennium ending 1905 was 42·7 per mille, as calculated upon the average census population for that period, but the census of 1911 showed there was a decrease of 1·7 per cent. of the population against an increase of 6·9 in the intercensal period 1891–1901 ; so that, at certain stages, the death rate must have been greater than that expressed, seeing that 355,381 people were gradually disappearing from the population. This great decrease was chiefly due to malaria and plague. The moral is that an intercensal period of ten years in India is inappropriate, and that, in view of imperfect registration and of the influence of epidemics and famines, the normal census should be supplemented by a simple numerical reckoning at quinquennial periods.

On the other hand, the use of the estimated population in India except in such extreme cases as quoted is likely to lead to a better approach to the truth than a bare reckoning upon the census population; for it is an absurdity in attempting to arrive at the value of sanitary efforts in a population, to point to great improvements in death-rates (under reasonable conditions of increase) reckoned upon the figures of a recently conducted census, as contrasted with, say, the last one or two years for the intercensal period, and, thereafter, to continue with each Annual Report the tone of complacency, till the actual increase of the population, and with it a numerical increase of deaths, renders apologies necessary.

What we believe is the correct course to adopt, in the face of poor registration results available in India and elsewhere in the tropics, is to follow the uniformity of plan which Lieutenant-Colonel Browning-Smith thinks necessary, by employing the census figures when referring to ordinary matters, but, where elucidation of special facts is required, there should be no hesitation in attempting to gain better light on the subject by using estimated populations in contrast. This is apparently also the conclusion to which the Punjab Government has committed itself in an ably written Review of the Sanitary Commissioner's Report.

There is at least another way in which the use of the estimated population may be of utility as a matter of routine, and get rid of much of the difficulty of incorrect registration. The man who trusts to getting a population well vaccinated, and therefore sees that a proportion of births (checked by the deaths) representing an infantile population is duly accounted for, may find himself confronted with extraordinary evidence of the want of efficacy of vaccination, by reason of a certain number not being overtaken by registration and traced thereby. In the Madras Presidency whilst, in deference to indigenous opinion, vaccination is deferred till an infant is six months of age, as contrasted with three months in Great Britain, there is yet reserved power of vaccinating within that period in the presence of smallpox, and compulsion is in force as to the unvaccinated up to ten years of age. With this explanation, it will be seen from the following stereotyped "letter form" (addressed to Municipal Chairmen who are responsible for legal working of the compulsory clauses, and in constant use as a check upon vaccination in the Municipalities of the Madras Presidency) that the use of the estimated population affords aid in gauging vaccination results. As a sample, the blanks of the form are filled with figures :—

"Taking into consideration the population of your town, as shown by the last census and the rate of increase then ascertained, there should survive to pass through the vaccinators' hands at the end of two periods of six months 2,099 infants before the end of the year 1894, of whom, allowing for 'leaving the town' and similar causes of disappearance, at least 94 per cent. should be returned as actually vaccinated. Again, it would not be unreasonable, taking into consideration the state of vaccination up to date in your town, to suppose that at least 30 per cent. of children between 1 and 5 years of age still require vaccination, giving a total of 3,698 *primary* vaccination cases. Further, if re-vaccination be effected on the very moderate scale of 3 per cent. of persons living between 10 and 15 (4,959) and 2 per cent. of persons between 20 and 25 (4,433), this class of operations should amount to the modest total of 238. In all, there should be therefore performed at least 3,936 operations this year, or about 328 cases per month against 120 performed by you."

Book Review.

Turner (J. A.) [M.D., D.P.H., Executive Health Officer, Bombay Municipality.] **Sanitation in India.** (With Contributions by B. K. Goldsmith, M.B., D.P.H.; S. C. Hormusji, L.R.C.P., M.R.C.S., M.D., D.P.H.; K. B. Schroff, L.M. & S., D.P.H., D.T.M.; and L. Godinho, L.M. & S., M.D., D.P.H.)—viii—1014 pp., 8vo. 1914. Bombay: The Times of India. [Price 15s. nett.]

Dr. Turner opens his book bearing the above title with the statement that he does not claim to have covered "the whole area of sanitation in India, which is a very wide one," and adds "there is in the book much that relates to purely local sanitary methods of a large city like Bombay, but we make no excuse for this, for we hold that the highest standard should be aimed at." Well, as both Calcutta and Madras are quite large cities and old enough to take care of themselves, it is not necessary to take up cudgels on their behalf; but so long as the halalkore system and its noisome shafts are in existence in Bombay, at least the value of the standard must be open to question. The author gives as the *raison d'etre* of the book the teaching of Sanitary Inspectors [Surveyors ?] "during twelve years" in Bombay City; but in a treatise dealing with the whole of India, with Bombay as its text, space might legitimately have been found for the statement that the Madras Presidency had preceded this by a *compulsory* ruling affecting both municipal and rural authorities during the last *twenty* years. Similarly, if any such historical retrospect was necessary for his purpose, it was desirable to add that also "twelve years" back, not only Bombay, but the Bengal Government, by a special grant, arranged to teach men of the Surveyor (B.E.) class for the same purpose.

The holding of the Health Officership of a city of the size of Bombay is no sinecure, and this fact is demonstrable in Dr. Turner's book. He evidently has allowed himself but little leisure from official duty to devote to this large work; so that a marked amount of duplication of information has escaped elimination in the final proof; a result perhaps facilitated by the treatment of the same subjects under different heads and certainly emphasized by it. For example, the description of the staff and duties of District Registrars, as stated at pp. 20–21, is reproduced and amplified at pp. 42–43; at p. 175, it is stated "wherever trenching is tried the manure finds a ready sale," but, in again treating the subject at p. 179, it is held "in many cases there is no sale for the resulting manure": at p. 494, the bacteriological methods of distinguishing cholera from other bacilli are stated, but these are repeated in an altered sequence at p. 489; at p. 411, a description of anthrax in animals is given, but this does not prevent the etiology of disease in animals being again discussed at p. 595, as a prelude to a reference to its occurrence in man; and whilst, at p. 411, cremation of an anthrax infected animal is alone advised, at p. 595 the alternative of burial is given; at pp. 572 and 573, respectively, details of the application of "pesterine" and the use of sunshine as a pulicidal measure are fully described, but are repeated at p. 722 and 723; the duties of Inspectors as to cholera are laid down at p. 509, and are repeated at p. 732 and 733. Occasional printer's errors occur, of which the most obvious is at page 107, where it is stated "as is well-known, the ordinary atmosphere contains about 4·04 per cent. of carbon dioxide."

If absence of leisure by a hard-worked official accounts for these undue repetitions, the punkah may well have been a disturbing factor in mixing the arrangement of "copy": as, in perusal, one is at times subjected to mental shocks, such as felt by the aviator in unexpected descents from one stratum to the other through "air holes." Thus, at p. 252, referring to relative cost, the opening paragraph of seven lines makes a general statement on the subject of cost of chemical or tank post-treatment, but the remainder of the section deals with the contrast between details of construction of "contact beds," whilst, under the latter heading, both

contact beds and percolating filters are described. It is an unexpected feature of this very involved treatment of sewage purification, for which Bombay is indebted for much original work conducted throughout ten years by Mr. JAMES (to which latterly Major Glen LISTON, I.M.S., and Dr. TURKHUD contributed), that nothing is stated as to the Matunga experiments; whilst the standard quantity of sewage per area of filter is dealt with by reference to an experiment in York, England.

On the subject of the disposal of waste, much useful information is given by the author; but his assertion that it is the "custom in Indian towns to throw the refuse and garbage in the streets and narrow lanes, where it is collected by the municipal staff twice or thrice daily" is not admissible—so far as the Madras Presidency is concerned. Where collection is not from house to house, in that considerable fraction of India, the inhabitants are required to deposit refuse in public dust-bins—usually movable—and normally do so; a fact of indirect interest as to rats and plague prevalence. Hence, the basis on which Dr. Turner calculates rubbish collection staffs is inapplicable to at least that part of India. Neither would it be possible to write this of the "Benighted (?) Presidency"—"every form of filth is thrown out of a window into the street, and packets of paper or leaves containing excreta may constantly be seen descending on the pavement or street, very often on the heads of the passers-by."

Dr. Turner is somewhat misleading as to organization of such parts of a Sanitary Service as exist in India. He conceives a Sanitary Commissioner with the Government of India with Deputy Sanitary Commissioners with Local Governments; the independent Sanitary Commissioners with the Local Governments are with the author negligible quantities. Equally, the author's ideas of extant sanitary law in India are incomplete and therefore misleading, even in regard to the Presidency of Bombay.

The author has reproduced rules used in Bombay for guidance of the municipal staff. These *a priori* ought to be useful to Municipal Health officers generally; but they disclose, throughout, the vain attempt to make Departments mutually check each other to such an extent that if duties required were really fulfilled, efficiency would be at a discount.

At page 94, Dr. Turner thus sums up the history of the discovery of the connection between the rat flea and plague: "Yersin's experiments prove conclusively that plague is communicable by ectozoa, especially rat fleas, principally *Pulex cheopis*, which act as passive intermediaries and carriers of the bacilli." Granted that YERSIN suggested the flea as an intermediary, it is certainly not on record that he brought conclusive proof. With OGATA originated the first experiment *ad hoc* by injection: the first proof was secured by SIMOND, and the rescue of that fact from oblivion, towards which it had drifted, by experimental proof is to the credit of Major Glen LISTON, I.M.S., and its wide applicability to the Members of the Indian Plague Investigations Committee. Several good illustrations are produced on the subject of plague; but the one showing the cooly putting down baits (page 563) with his hands, hardly realizes the ideal of preventing the undesirable suspicion of human contact owing the sense of smell of the rat.

In matters connected with food inspection, Dr. Turner is at his best. Yet hasty editing is apparent in the treatment of beriberi: for whilst Baron TAKAKI'S as well as BRADDON'S theory is detailed, no allusion is made to the work of FRASER and STANTON, nor the efforts of Major GREIG, I.M.S., in expanding the findings of the latter authorities.

The author, in discussing anti-smallpox vaccination, unwittingly does his countrymen an injustice in repeating the old calumny of the interpolation into the Shastras by stating that "Ellis of Madras" perpetrated a "pious fraud," in representing that vaccination was an ancient Hindu institution. This controversial matter has been thoroughly threshed out from time to time, and it has been shown that there is no evidence to connect the only ELLIS of Madras of the period concerned, whose knowledge of Sanscrit would have sufficed for this dishonourable conduct. If he were in any way connected with the matter, it was as sceptic, not as a perpetrator. Nor, indeed, has it been established, whilst there is ground for suspicion that the passage referred to is a fraud.

More time devoted to editing a second edition will get rid of defects we have mentioned, as well as bring into better relief the fact that throughout the book are scattered sound sanitary doctrines, which will certainly cause it to fill a useful position in the library of those interested in sanitation in the Tropics.

W. G. K.

Savage (William G.). [B.Sc., M.D. (Lond.), D.P.H.] **The Bacteriological Examination of Food and Water.** Cambridge Public Health Series.]—x + 174 pp. Demy 8vo. with 16 illustrations. 1914 : Cambridge University Press. [Price 7*s.* 6*d.* net].

The aim of the Cambridge Public Health Series is the production by well known authorities of books which shall bring together scientific observations in a form which shall favour their being used practically—that is, the necessities not of the bookworm but of the man of applied hygiene are considered. This end has been well met in one of the latest issues of the series, " The Bacteriological Examination of Food and Water "; so that the reader will find condensed within 170 pages the bulk of extant information on the subjects treated, without the trouble of deciding the rival claims of bacteriologists as to whether their particular methods are those which can alone secure trustworthy results.

The book does not afford special experience derived from the tropics, and therefore whilst the important truths as to bacteriology of water supplies which Houston's work has so fully established for temperate climates must remain the standard of comparison, the reader must be prepared to realise that there are differences in the vitality of certain microbes in the tropics, and hold in mind the dicta of Major Clemesha, I.M.S., in his " Bacteriology of Surface Waters in the Tropics."* But, so far, the records of the bacteriology of food as found in hot climates are negligible in quantity, and consequently, the worker there will find brought together in this book information of great value which is otherwise not obtainable, except in exasperatingly scattered literature. Its perusal will at least cause the man in the tropics to realise more fully than generally is the case that the care of the health of the " white in the tropics " does not end with screening his quarters from mosquitoes, flies or rats, or providing a good water supply. He will find the invaliding and death-rate undesirably high, so long as his measures of prevention do not affect the larder, the kitchen *and the cook*. The average Englishman if he realises at all the horrors that exist is apt to regard them as inevitable, and to believe that " if ignorance is bliss 'tis folly to be wise," and blames the climate for mysterious ill-health instead of his kitchen. There is natural reluctance of the medical man to pry into conditions which are intimately domestic and private—but many lives would be saved in the tropics if, before writing his prescription, the medical man would invade the sacred, and often vile, precincts of the kitchen. No casual inspection will suffice ; he must be prepared to hunt every nook and cranny of the kitchen and larder for evidence of filthy towels, tables, cooking utensils and bacteriologically ridiculous methods of storage and use of milk, water, ice, and various foods. We can safely commend the teachings of this concise book as likely to afford sound assistance as to the directions which such search should take.

Nor should the artistic *chef* of the tropics and his personal habits be regarded as negligible factors, in the hunt for the *fons et origo mali*. A useful experience in this direction has been placed on record by Drs. J. A. Haran and Alexander Robertson†, in Appendix 1 of the Annual Medical Report of the East Africa Protectorate for 1912, where it is shown that 14 cases of enteric fever at Nairobi were of kitchen origin. The reporting officer, after offering evidence incriminating the hands of natives in

*1912. Calcutta : Thacker, Spink & Co. London : E. & F. N. Spon, Ltd.

†Report on Cases of Enteric Fever in Nairobi between October, 1911, and March, 1912.—*E. Africa Prot. Ann. Med. Rept. for year ending 21st Dec.*, 1912. pp. 60-65.

domestic service, concludes :—" From a consideration of the circumtances attending all these cases, we have come to the conclusion that the majority, if not all of them, were probably due to contamination of food resulting from the hands of the patients having become infected by contact with matter containing the germs of enteric fever."

Dr. Arthur STANLEY, of Shanghai, has taken up the question of " Kitchen hygiene " with vigour, and not only recognizes the position of the Medical Officer of Health on the subject,* but demands the attention of architects to requisite structural conditions ; and to show his faith goes with his words, he invites persons about to visit houses locally to ask for a sanitary inspection, which he gives without fee. On this subject of work without pay, we recognize that he who makes a single blade of grass grow where none was before has the satisfaction of knowing he is a benefactor of mankind ; but it is our opinion that a sanitarian who stifles his reluctance to interfere in domestic matters, and dares at once the indignation of the housewife and cook by condemning kitchen arrangements in the tropics, deserves a more *palpable* honorarium from Government invaliding Committees, Life Insurance Societies and Orphan Funds.

W. G. K.

*Shanghai Municipal Council, Health Department, Annual Report, 1912, p. 32.

A letter was received from Dr. Robert LESK in May, commenting upon a review published in this *Bulletin* in January (Vol. 3, p. 69) on the Complications of Amoebic Dysentery. An explanation of the point to which Dr. Lesk drew attention was inserted in *Bulletin* No. 10, p. 570. Dr. Lesk writes again asking that his original letter be published.

" Bemerkungen zu dem Referat des S.R.D. (Douglas) über Lesk (Robert): Ueber seltenere Komplikationen der Amoeben-Dysenterie etc. im *Tropical Diseases Bulletin* January 30, 1914, pagina 69 :

" Der Referent (S.R.D.) ist der deutschen Sprache nicht so weit mächtig, um das Recht beanspruchen zu können, eine deutsche Publication zu beurtheilen. Als Beweis : In seinem Referat kommt der Referent zur Auffassung, dass der Kranke mit Parotitis von der Dysenterie geheilt war und dann die Parotitis bekam (" einige Monate zuvor Dysenterie gehabt zu haben.") Der Wortlaut im Original ist :—" schon einige Monate an Dysenterie litt." Das bedeutet deutsch, dass der Kranke seit einigen Monaten Dysenterie hatte und augenblicklich—zur Zeit der Parotitis—die Dysenterie noch hatte.

Mit der Konstatierung dieser Thatsache erübrigt es sich, weiter auf Details einzugehen. Erwähnt sei nur, dass Gemeinplätze angeführt sind, da es sich um eine Publikation handelt auf Grund eines Vortrages mit Krankendemonstration."

DR. ROBERT LESK.

Weltevreden, 2. 5. 1914.

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BOOKS RECEIVED.

GRAHAM-SMITH (G. S.) [M.D.] Flies in Relation to Disease.—Non-Bloodsucking Flies.—2nd Edition. xvi + 389 pp. With 32 text-figs., 27 plates and 20 charts. Demy 8vo. 1914. Cambridge: at the University Press. [Press 12*s.* 6*d.* net.]

TROPICAL DISEASES RESEARCH FUND. Report of the Advisory Committee for the Tropical Diseases Research Fund for the Year 1913.—iv + 239 pp. F'cap. 1914. London. Printed under the Authority of H.M. Stationery Office. [Cd. 7261. Price 2*s.* 4*d.*]

SLEEPING SICKNESS COMMITTEE. Report of the Inter-Departmental Committee on Sleeping Sickness.—26 pp. F'cap. 1914. London. Printed under the Authority of H.M. Stationery Office. [Cd. 7349. Price 3*d.*]

SLEEPING SICKNESS COMMITTEE. Minutes of Evidence taken by the Departmental Committee on Sleeping Sickness.—330 pp. F'cap. 1914. London. Printed under the Authority of H.M. Stationery Office. [Cd. 7350. Price 2*s.* 8*d.*]

COLONY OF THE GAMBIA. Annual Report of the Medical Department for the Year 1913.—48 pp. F'cap. With plan. 1914. London. Printed by Waterlow & Sons, Ltd.

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